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Example Emission Inventory Documentation for 1982: Ozone State Implementation Plans (SIPs)

Engineering-Science, Inc.
Durham, NC

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Example Emission Inventory Documentation For 1982 Ozone State Implementation Plans (SIPs)

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16. ABSTRACT

This report contains example documentation showing the items and format required as part of the VOC/NOx emission inventory submittals for the 1982 ozone SIPs. EPA's summary reporting tables are exemplified. Documentation on point, area, and highway vehicle sources is included.

17. KEY WORDS AND DOCUMENT ANALYSIS

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PREFACE

This document complements recent EPA guidance*,** on compiling reactive VOC and NO_x emission inventories for use in developing the 1982 ozone State Implementation Plans (SIP's). Specifically, an example inventory is presented and documented wherein emissions of reactive VOC and NO_x have been compiled for an imaginary ozone nonattainment area called Ozoneville. Emission totals are developed for area, point, and highway vehicle sources for a base year (1980) as well as a projected attainment year (1987). Two projection inventories are developed: 1) a baseline projection, considering growth and on-the-books controls implemented in the 1979 SIP's and 2) a SIP strategy projection, which also considers the impact of control measures incorporated in the 1982 ozone SIP's.

Several qualifications should be kept in mind when using this document. First, many of the data presented are ficticious, although selected to be fairly realistic. As such, they should not be applied indiscriminately to any areas or source categories in lieu of using local data. Moreover, the types and extent of controls hypothetically imposed in Ozoneville to achieve the ozone standard may be quite different than those required in other areas.

A second qualification is that all of the types of point sources of VOC and NO_x that will likely be encountered in a real inventory situation are not exemplified in this document for the sake of brevity. The inventorying agency's actual point source inventory will necessarily have to encompass many more sources of VOC (including many to which RACT is applicable) than have been included in this example inventory. In contrast, the sections on area and highway vehicle sources in this document are fairly inclusive because of the limited number of source categories that must be dealt with in each of these areas.

Finally, it should be noted that this document combines both the baseline and SIP strategy inventories. According to EPA's ozone SIP inventory requirements,** the SIP strategy inventory and accompanying documentation need not be submitted until July 31, 1982, or seven months after submittal of the base year and baseline projection inventories. For convenience of both preparation and subsequent review, it is recommended that the SIP strategy inventory and documentation be combined with the base year and baseline projection inventories for the final submittal accompanying the 1982 SIP.

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* Procedures for the Preparation of Emission Inventories for Volatile Organic Compounds: Volume I. Second Edition. EPA-450/2-77-028

**Final Emission Inventory Requirements for 1982 Ozone State Implementation Plans. EPA-450/4-80-016

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1.0 EXECUTIVE SUMMARY

States with areas classified as nonattainment with respect to the National Ambient Air Quality Standards (NAAQS's) were required by the Clean Air Act Amendments of 1977 to submit attainment plans in 1979 which demonstrated attainment by 1982. States which were unable to show attainment of the carbon monoxide and ozone standards by 1982 were granted extensions to 1987 for attainment. Plans demonstrating attainment by 1987 are required by July 1, 1982.

This document presents the emission inventory for reactive volatile organic compounds (VOC) and oxides for nitrogen (NO_x) from nonhighway area, point, and highway sources for the photochemical oxidant nonattainment area around Ozoneville. A map of the Ozoneville nonattainment area is shown in Figure 1.1. The nonattainment area encompasses County A, County B, County C, and County D. In Figure 1.1, the crosshatching indicates the corporate limits of Ozoneville. The 1980 Census population is 2,061,978 for this standard metropolitan statistical area (SMSA).

A number of agencies were involved in preparing various portions of the Ozoneville inventory. The lead agency was the Ozoneville Regional Planning Authority (ORPA). ORPA was directly responsible for overseeing the completion of each segment of the inventory, for running city-specific EKMA, and for developing the control measures implemented in the 1982 SIP. Other agencies provided data to ORPA necessary for compiling emission estimates. The State Department of Environmental Regulation (DER) and Ozoneville Department of Public Health (ODPH) provided various activity level data for use in the area source inventory. Mail survey results from the DER were the primary means of updating the point source inventory. The Ozoneville Department of Transportation (ODOT) and various other State and local agencies provided data and technical assistance necessary for running the transportation and network calculation models.

Tables 1.1 and 1.2 summarize reactive VOC and NO_x emissions for the entire Ozoneville nonattainment area. Emissions are presented for the base year, 1980, and the projected attainment year, 1987. The baseline projection totals reflect growth to 1987 as well as on-the-books controls (primarily as a result of the 1979 SIP). The SIP strategy totals reflect additional control measures committed to in the 1982 SIP. The stationary source emission categories in Table 1.1 are defined to reflect the application of reasonably available control technology (RACT).

The 1980 emission totals were based on the most recent data available. Area source totals were based on current population and employment data developed by the Ozoneville Regional Planning Authority (ORPA). Point source totals were based on a 1980 mail survey, recent stack tests, and existing files. Highway vehicle totals were computed by applying EPA emission factors (MOBILE 1) to travel estimates resulting from ORPA's ongoing transportation planning process.

The 1987 baseline projections for point and area sources were determined by applying the appropriate growth factors to the 1980 emissions from individual

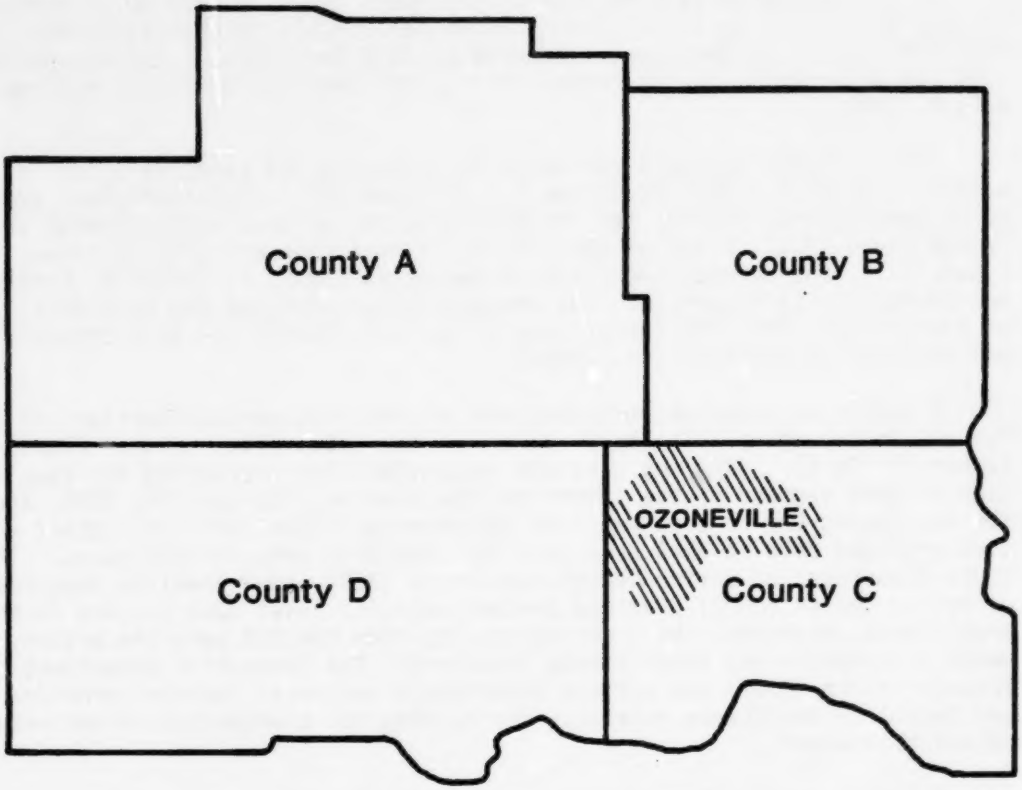
County A
County B
OZONEVILLE
County D
County C

FIGURE 1.1 Ozoneville Study Area.

TABLE 1.1. SUMMARY OF REACTIVE VOC EMISSIONS FOR THE OZONEVILLE NONATTAINMENT AREA
(kg/day, typical summer weekday)

Emission Source	Base Year 1980		Attainment Year			
			Baseline projection		SIP strategy	
	Point	Area	Point	Area	Point	Area
STORAGE, TRANSPORTATION, & MARKETING OF VOC						
Oil and Gas Production & Processing						
Gasoline and Crude Oil Storage[1]	6,160		703		703	
Synthetic Organic Chemical Storage&Transfer						
Ship and Barge Transfer of VOC						
Barge and Tanker Cleaning						
Bulk Gasoline Terminal[2]						
Gasoline Bulk Plant[3]						
Service Station Loading (Stage I)		6,341		4,439		4,439
Service Station Unloading (Stage II)		7,593		9,568		7,200
Other (specify) Tank Breathing/Truck Transit		1,076		1,355		1,355
INDUSTRIAL PROCESS						
Petroleum Refinery						
Lube Oil Manufacture						
Organic Chemical Manufacture	785		196		196	
Inorganic Chemical Manufacture						
Fermentation Process						
Vegetable Oil Processing						
Pharmaceutical Manufacture						
Plastic Products Manufacture						
Rubber Tire Manufacture	3,697		1,998		1,507	
SBR Rubber Manufacture						
Textile Polymers & Resin Manufacture	1,965		1,965		393	
Synthetic Fiber Manufacture						
Iron and Steel Manufacture						
Other (specify)________________________						
INDUSTRIAL SURFACE COATING						
Large Appliance						
Magnet Wire	1,365		137		137	
Automobile						
Can						
Metal Coil	720		292		292	
Paper	9,820		4,716		4,716	
Fabric	15,192		7,509		7,509	
Metal Wood Product	822		714		714	
Miscellaneous Metal Product						
Plastic Parts Painting						
Large Ship						
Large Aircraft						
Other (specify)________________________						

(continued)

TABLE 1.1 (continued)

Emission Source	Base Year 1980		Attainment Year			
			Baseline projection		SIP strategy	
	Point	Area	Point	Area	Point	Area
NONINDUSTRIAL SURFACE COATING						
Architectural Coatings		11,788		12,374		12,374
Auto Refinishing		9,691		10,179		10,179
Other (specify) ________________						
OTHER SOLVENT USE						
Degreasing	166	8,994	112	4,532	112	4,532
Dry Cleaning	5,360	3,710	7,783	1,930	2,383	1,172
Graphic Arts	1,216	1,682	685	1,147	465	670
Adhesives	0	0	0	0	0	0
Cutback Asphalt		1,161		0		0
Solvent Extraction Process		0		0		0
Consumer/Commercial Solvent Use		16,144		16,946		16,946
Other (specify)________________						
OTHER MISCELLANEOUS SOURCES						
Fuel Combustion	158	294	228	298	228	298
Solid Waste Disposal		5,725		6,010		6,010
Forest, Agricultural, & Other Open Burning		1,271		1,318		1,318
Pesticide Application		1,166		1,250		1,250
Waste Solvent Recovery Process	15	0	18	0	9	0
Stationary Internal Combustion Engine		196		196		196
MOBILE SOURCE						
Highway Vehicle						
Light Duty Automobile		79,990		38,063		36,062
Light Duty Trucks		11,540		5,488		4,603
Heavy Duty Gasoline Trucks		9,312		4,431		4,380
Heavy Duty Diesel Truck		4,338		2,064		2,042
Motorcycle		635		302		294
Off-Highway Vehicle		5,753		6,111		6,111
Rail		3,114		3,114		3,114
Aircraft		649		783		783
Vessel						
TOTAL	47,441	192,163	27,056	131,898	19,364	125,328

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[1] Excludes storage facilities at service stations and bulk plants.

[2] Emissions from loading tank trucks and rail cars.

[3] Emissions from storage and transfer operations.

TABLE 1.2. SUMMARY OF NO_x EMISSIONS FOR THE OZONEVILLE NONATTAINMENT AREA
(kg/day, typical summer weekday)

Emission Source	Base Year 1980		Attainment Year			
			Baseline projection		SIP strategy	
	Point	Area	Point	Area	Point	Area
EXTERNAL FUEL COMBUSTION						
Utility Boiler	50,889		58,979		58,979	
Industrial Boiler						
Commercial, Institutional, Residential		16,967		17,289		17,289
STATIONARY INTERNAL COMBUSTION						
Reciprocating Engine		4,702		4,702		4,702
Gas Turbine						
INDUSTRIAL PROCESS						
Chemical Manufacturing						
Adipic Acid						
Nitric Acid						
Other						
Iron and Steel						
Mineral Products						
Cement						
Glass						
Other						
Petroleum Refining						
Other						
INCINERATION AND OPEN BURNING		1,861		1,985		1,985
MOBILE SOURCE						
Highway Vehicles						
Light Duty Automobile		51,866		39,290		36,701
Light Duty Truck		6,539		4,953		4,158
Heavy Duty Gaoline Truck		7,422		5,622		5,534
Heavy Duty Diesel Truck		22,549		17,048		16,920
Motorcycle		26		20		20
Off-Highway Vehicles		6,366		6,862		6,862
Rail		11,579		11,579		11,579
Aircraft		284		355		355
Vessel						
TOTAL	50,889	130,050	58,979	109,589	58,979	105,989

companies or emission categories and by accounting for emission reductions already scheduled by Ozoneville's 1979 SIP revision. The 1987 control strategy emissions were calculated by applying the additional RACT category emission reductions contained in the 1982 SIP revision to the 1987 baseline projection emissions.

The presumed emission reductions resulting from the application of the 1979 and 1982 RACT measures were generally derived from the respective CTG's. Note that in the 1982 SIP, RACT was determined to be available for several categories in Ozoneville for which Control Technology Guidelines (CTG) have not been published by EPA. These additional controls were necessary to project achievement of the National Ambient Air Quality Standard (NAAQS) for ozone by 1987.

Highway vehicle travel estimates were projected by applying ORPA's standard four-step transportation modeling process to future estimates of population, households, and employees. Non-linear interpolation of projections originally produced for 1977 and 2000 was performed to develop travel estimates for 1980 and 1987. The bulk of the projected reductions in highway vehicle emissions are due to the Federal Motor Vehicle Control Program (FMVCP) and inspection/maintenance (I/M). Each of these is reflected in the MOBILE 1 emission factors. The impact of transportation measures (RACM's) was primarily simulated by evaluating reductions in regional travel resulting from each package of measures.

The VOC's in this inventory are photochemically reactive. All identified nonreactive VOC's (e.g., methane, ethane, and halogenated organics) were excluded from VOC totals for each source. Table 1.3 lists the nonreactive VOC's.

Section 2.0, 3.0 and 4.0 present the area source, point source, and highway vehicle emission inventory documentations, respectively. Section 5.0 provides a description of the quality assurance program used to ensure that the inventory contained accurate and complete data.

TABLE 1.3 NONREACTIVE VOLATILE ORGANIC COMPOUNDS

Methane
Ethane
1,1,1-Trichloroethane (methyl chloroform)
Methylene chloride
Trichlorofluoromethane (CFC 11)
Dichlorodifluoromethane (CFC 12)
Chlorodifluoromethane (CFC 22)
Trifluoromethane (FC 23)
Trichlorotrifluoroethane (CFC 113)
Dichlorotetrafluoroethane (CFC 114)
Chloropentafluoroethane (CFC 115)

Sources: 42 FR 35314 - July 8, 1977
45 FR 48941 - July 22, 1980

2.0 AREA SOURCES

This section documents the development of the area source emission inventory for reactive volatile organic compounds (VOC) and oxides of nitrogen (NO_x). Area sources include non-highway mobile and stationary sources that are too small or too numerous to be treated individually as point sources. Table 2.1 lists the categories of area source VOC and NO_x emissions. Highway vehicle sources are discussed in Section 4.0.

The emissions in the inventory are typical of a weekday during the summer ozone season. The base year is 1980 and the projected attainment year is 1987. Two projection inventories were made. First, baseline emissions were projected for 1987 accounting for growth and controls scheduled in the 1979 SIP. Also, a 1987 control strategy projection year inventory was developed to include the proposed controls in the 1982 SIP.

Several documents provided basic guidance for the development of the area source emission inventory. The first is Procedures for the Preparation of Emission Inventories for Volatile Organic Compounds Volume I, Second Edition, EPA-450/2-77-028, referred to as Volume I. Emission factors were generally taken from Compilation of Air Pollutant Emission Factors (Including Supplements 1-10), AP-42, and appropriate Control Technology Guidelines (CTG's). The structure and content of the inventory was based on guidance presented in Final Emission Inventory Requirements for 1982 Ozone State Implementation Plans, EPA-450/4-80-016. Nonreactive VOC were excluded from the inventory based primarily on data in Volatile Organic Compound (VOC) Species Data Manual, EPA-450/4-80-015 (2nd Edition), hereafter referred to as the VOC Species Manual. Basic demographic and employment data for both the base year of 1980 and the projection year of 1987 were provided by the Ozoneville Regional Planning Authority (ORPA). Table 2.2 summarizes the basic demographic and employment data. Other sources of information included the Ozoneville Department of Public Health (ODPH) and the State Department of Environmental Regulation (DER). A complete list of references is given in Section 2.6.

The documentation for each area source category is addressed in the following manner. First, the area source category is defined and the base year activity parameter calculations are discussed. The emission factor for the source category is given and referenced. The baseline projection factors are then developed, reflecting growth and "on the books" controls. Finally, any additional emission reductions from controls proposed by the 1982 SIP are briefly described.

TABLE 2.1. AREA SOURCES OF REACTIVE VOC AND NO_x

Gasoline Distribution

Nonindustrial Surface Coating

- Architectural Coatings
- Auto Refinishing

Other Solvent Use

- Degreasing
- Dry-cleaning
- Graphic Arts
- Cutback Asphalt Paving
- Commercial/Consumer Solvent Use

Other Miscellaneous Sources

- Stationary Source Fuel Combustion
- Solid Waste Disposal
- Forest, Agriculturing, and Other Burning
- Pesticide Application
- Stationary Internal Combustion Engines

Non-highway Mobile Sources

- Off-highway Vehicles
- Railroad Locomotives
- Aircraft
- Vessels

TABLE 2,2. POPULATION AND EMPLOYMENT DATA

			Employment									
	Population		Manufacturing		Construction		Wholesale		Retail		Commercial/ Institutional	
County	1980	1987	1980	1987	1980	1987	1980	1987	1980	1987	1980	1987
A	675,048	714,994	118,373	120,396	25,709	26,595	18,292	18,602	53,923	57,386	158,641	170,989
B	301,727	310,517	40,802	41,362	5,826	5,834	3,809	3,896	16,177	16,786	54,762	57,436
C	612,400	636,628	61,417	62,546	13,500	13,664	6,917	7,221	36,554	39,172	102,654	114,535
D	472,803	502,153	57,562	57,739	10,739	10,844	7,794	4,840	30,087	30,870	84,639	87,816

Source: Employment and Demographic Data Summaries by Census Tract, Minor Civil Division, and County 1970-2000, Ozoneville Regional Planning Authority. These data are consistent with projections developed for Ozoneville in accordance with EPA's cost-effectiveness guidelines for wastewater treatment facilities.

2.1 GASOLINE DISTRIBUTION

Four subcategories involving gasoline distribution losses were inventoried as area sources: (1) tank truck unloading (Stage I), (2) vehicle fueling (Stage II), (3) underground tank breathing, and (4) tank truck transit. Volume I recommends evaluating gasoline distribution losses by these subcategories so that Stage I and Stage II control measures can be more readily simulated when projecting emissions. The activity level for each subcategory is gasoline sales. All gasoline distribution losses can be considered photochemically reactive, as indicated in the VOC Species Manual.

The state Bureau of Liquid Fuels Taxation was contacted to obtain 1980 gasoline sales data. Sales data was available by county and included both taxable and non-taxable gasoline sales. The Bureau of Liquid Fuels Taxation could not provide a seasonal variation in the sale of gasoline, however. Data from Highway Statistics 1978 was used to determine a seasonal scaling factor. Gasoline sales throughout the state during the summer months were 26% of the yearly sales. Although this data is specific for 1978, the seasonal variation in gasoline sales was assumed to be the same from year to year. No weekday adjustment was made based on information supplied by the Bureau of Liquid Fuels Taxation. The seasonally adjusted amount of gasoline marketed per day by county is listed in Table 2.3.

For tank truck unloading, the percentage of gasoline delivered by each of the three types of filling methods was determined. A random telephone survey of 50 service stations revealed that 80 percent of the service stations in the study area are equipped for submerged filling while the remaining 20 percent employ splash filling. No service stations employed balance submerged filling (Stage I vapor recovery) in 1980. Using the hydrocarbon emission factors given in Table 4.4-5, AP-42, a weighted emission factor of 8.1 lbs/1000 gallons throughput was calculated. Table 2.4 lists base year VOC emissions from tank truck unloading during a typical day in the ozone season for each county in the study area.

An emission factor of 9.7 lb/1000 gallons throughput is given in Table 4.4-4 of AP-42 for vehicle fueling operations which are not equipped with controls. Spillage accounts for 0.7 lbs/1000 gallons. The AP-42 emission rate for underground tank breathing losses is 1 lb/1000 gallons throughput. Table 2.4 lists base year VOC emissions from vehicle fueling and underground tank breathing.

Table 4.4-3 of AP-42 lists emission factors for tank truck transit losses. These factors are given for gasoline transferred in two modes: (1) tanks loaded with fuel, and (2) tanks returning with vapor. Volume I suggests the two factors be added together to obtain a compound factor applicable to a round trip delivery. Typical and extreme values for transit losses are given in Table 4.4-3 of AP-42. An average of the two values was used. The round trip delivery emission factor for tank truck transit losses was calculated to be 0.29 lbs/1000 gallons transferred. This factor could not be applied to the gasoline sales estimated given in Table 2.3 since the amount of gasoline transferred in an area may

TABLE 2.3. ESTIMATED GASOLINE SALES DURING THE 1980 OZONE SEASON, OZONEVILLE STUDY AREA

County	Estimated Gasoline Sales (gals/day)
A	550,300
B	253,300
C	499,200
D	374,600

TABLE 2.4. SUMMARY OF GASOLINE DISTRIBUTION LOSSES

		Reactive VOC Emissions (kg/day)		
County	Operation	Base Year	Baseline Projection	Control Strategy
A	Tank Truck Unloading	2,067	1,447	1,447
	Vehicle Fueling	2,475	3,119	2,347
	Underground Tank Breathing	255	321	321
	Tank Truck Transit	96	121	121
		4,893	5,008	4,236
B	Tank Truck Unloading	951	666	666
	Vehicle Fueling	1,139	1,435	1,080
	Underground Tank Breathing	117	147	147
	Tank Truck Transit	44	55	55
		2,251	2,303	1,948
C	Tank Truck Unloading	1,875	1,313	1,313
	Vehicle Fueling	2,245	2,829	2,129
	Underground Tank Breathing	231	291	291
	Tank Truck Transit	87	110	110
		4,438	4,543	3,843
D	Tank Truck Unloading	1,448	1,013	1,013
	Vehicle Fueling	1,734	2,185	1,644
	Underground Tank Breathing	179	226	226
	Tank Truck Transit	67	84	84
		3,428	3,508	2,967

exceed gasoline sales because some gasoline is delivered from bulk terminals to bulk plants before it is delivered to service stations. From the point source inventory and 1980 gasoline sales data it was determined that, on the average, 30% of the gasoline sold in the study area was stored at bulk plants. Therefore, the gasoline sales values listed in Table 2.3 were multiplied by 1.30 before the round trip delivery emission factor was applied. Tank truck transit losses are listed for each county in Table 2.4.

The ORPA estimated an annual growth in gasoline sales of 3.4% for the study area. The state fuel tax office agreed that this rate was a reasonable assumption. The 3.4% annual growth rate was used to project gasoline distribution losses to 1987. The growth factor calculated from this annual rate is 1.26. The 1979 SIP required approximately 40% of the service stations in the study area to receive gasoline by balanced submerged filling (Stage I vapor controls). All other service stations were required to implement submerged filling. No splash filling will be permitted. The emission factors in Table 4.4-4 were used to calculate a weighted emission factor of 4.5 lb/1000 gallons throughput for tank truck unloading. No additional controls on tank truck unloading will be established in the 1982 SIP. Therefore, the growth factor of 1.26 along with the weighted emission factor was applied to the 1980 ozone season gasoline sales in Table 2.3 to calculate VOC emissions from tank truck unloading for both projection year inventories. VOC emissions from tank truck unloading on a typical day during the 1987 ozone season are presented for each county in Table 2.4.

No controls on vehicle fueling operations (Stage II vapor controls) were established in the 1979 SIP. However, the 1982 SIP requires 30% of the service stations in the study area to install State II vapor controls. The emission factors found in Table 4.4-4 of AP-42 were used to calculate a compound emission factor of 7.3 lbs/1000 gallons throughput for vehicle fueling operations. The baseline projection emissions from vehicle fuel were calculated by multiplying the base year emissions by the 1.26 growth factor. The control strategy emissions were calculated by multiplying 1980 ozone season gasoline sales by 1.26 and applying the compound emission factor of 7.3 lbs/1000 gallons throughput. Table 2.4 lists VOC emissions from vehicle refueling operations for both projection year inventories.

No controls on underground tank breathing losses and tank truck transit losses are established in either the 1979 or 1982 SIP. Therefore, the growth factor of 1.26 was used to project these losses for both projection year inventories. These emissions are summarized for each county in Table 2.4.

2.2 NONINDUSTRIAL SURFACE COATING

Industrial surface coating operations have been included in the point source inventory. Architectural surface coating and automobile refinishing are major nonindustrial surface coating sources and were inventoried as area sources.

2.2.1 Architectural Surface Coating

The most accurate method of inventorying VOC emissions from the application of architectural surface coatings is to obtain sales and distribution data from local wholesale and retail suppliers of solventborne paints, varnishes, and other coatings. Due to manpower and budget constraints, this method could not be employed to estimate VOC emissions. Instead, the national average factor of 4.6 pounds of emissions per capita per year recommended in Volume I was used. All the VOC emissions from this source category are photochemically reactive. No seasonal adjustment is believed to be warranted in Ozoneville because winter temperatures are warm enough to allow outdoor painting. Likewise, weekday/weekend adjustment seems unwarranted since painting is as likely to occur during weekdays as on the weekend. Table 2.5 lists the base year VOC emissions from architectural surface coating in the four county Ozoneville study area.

No VOC emission reductions will occur either as a result of the 1979 or the 1982 SIPs. Therefore, the projection year VOC emissions were projected based upon 1980-1987 population growth. Table 2.5 lists VOC emissions from architectural surface coating by county for the base year projection years.

2.2.2 Automobile Refinishing

Two alternative methods are given in Volume I for estimating emissions from automobile refinishing if local data are unavailable. One method is to apply a factor of 1.9 lbs/capita year to total population. The other method is to apply a factor of 2.6 TPY/employee to the number of employees in SIC codes 7531 and 7535. Since the emissions per employee method gives more conservative estimates, this method was used to determine baseline VOC emissions. VOC emissions were projected to grow with the increase in population from 1980-1987. All solvent is assumed to be reactive. No seasonal adjustment is necessary. Emissions are assumed to occur uniformly from Monday to Saturday. Hence, annual emissions are divided by 312 rather than 365 to estimate weekday emissions. A summary of baseline and projection year emission inventories is given in Table 2.6.

2.3 OTHER SOLVENT USE

2.3.1 Degreasing, Small Industrial/Commercial

Open top vapor and conveyorized degreasing have been included in the point source inventory. Cold cleaning degreasing is the only type which will be treated as an area source. No cold cleaning solvent use was identified in the point source inventory. Volume I recommends a factor of 3 pounds of reactive VOC per capita per year for estimating small cold cleaning emissions. No seasonal adjustment is necessary. Emissions are assumed to occur uniformly from Monday to Saturday. Table 2.7 lists the base year reactive VOC emissions from cold cleaning degreasing for each county in the Ozoneville study area.

TABLE 2.5. VOC EMISSIONS FROM ARCHITECTURAL SURFACE COATING

	Reactive VOC Emissions (kg/day)		
County	Base Year	Baseline Projection	Control Strategy
A	3,859	4,091	4,091
B	1,725	1,777	1,777
C	3,501	3,641	3,641
D	2,703	2,865	2,865

TABLE 2.6. SUMMARY OF AUTOMOBILE REFINISHING VOC EMISSIONS

		Reactive VOC Emissions (kg/day)		
County	Employment[a] in SIC's 7531 and 7535	Base Year	Baseline Projection	Control Strategy
A	440	3,326	3,526	3,526
B	179	1,354	1,394	1,394
C	342	2,585	2,688	2,688
D	321	2,426	2,571	2,571

[a] Reference: County Business Patterns 1980, Bureau of the Census, U.S. Department of Commerce.

TABLE 2.7. VOC EMISSIONS FROM COLD CLEANING DEGREASING

	Reactive VOC Emissions (kg/day)		
County	Base Year	Baseline Projection	Control Strategy
A	2,945	1,499	1,499
B	1,316	650	650
C	2,671	1,334	1,334
D	2,062	1,049	1,049

The RACT established in the 1979 SIP for cold cleaning degreasing will result in a 52% reduction in reactive VOC emissions from this source category. No additional emission reductions will occur as a result of the 1982 SIP. Consequently, VOC emissions from cold cleaning degreasing can be projected to 1987 by multiplying baseline emissions by population growth factors and a reduction factor of 48%. Table 2.7 lists the projected reactive VOC emissions for each county.

2.3.2 Dry Cleaning

A survey of commercial and coin operated dry cleaners was conducted for calendar year 1980 for County A. A brief survey form was developed to obtain the following information: amount and type of cleaning solvent used; number of employees; quarterly throughput; and type of control device (if any). The questionnaires achieved a 90% response and accounted for 85% of the employees within the 7215 and 7216 SIC codes as reported in County Business Patterns 1980. (Note: Industrial dry cleaning, covered by SIC 7218, is covered in the point source inventory; see Section 3.8.)

Emissions for County A were calculated using the survey data and the assumption from AP-42 that all solvent input to dry-cleaning operations is eventually evaporated to the atmosphere, so that the emission factor is 2,000 lbs/ton. From the survey, the emissions from commercial and coin operated plants totaled 202 tpy of perchloroethylene and 86 tpy of petroleum solvent. The emissions from commercial and coin operated plants were scaled up in the following manner to account for establishments not responding to the survey:

$$\begin{array}{c}\text{Nonreported}\\\text{Emissions}\end{array} = \frac{\text{Reported Emissions}}{\text{Reported Employment}} \times \begin{array}{c}\text{Total}\\\text{Employment}\end{array} - \begin{array}{c}\text{Reported}\\\text{Emissions}\end{array}$$

$$= \frac{288\text{ tpy}}{519\text{ employees}} \times 611\text{ employees} - 288\text{ tpy} = 51\text{ tpy}$$

The nonreported emissions were assumed to have the some solvent type split as the reported emissions.

The results of the survey were used to develop an emission-per-employee factor for commercial and coin-op plants that was used to determine emissions in the surrounding counties. The factors are 0.40 tpy per employee for perchloroethylene solvents and 0.17 tpy per employee for petroleum solvents. (Note: These emission-per-employee factors are specific for Ozoneville and are not recommended for general application.) These emission-per-employee factors were applied to employment within the 7215 and 7216 SIC categories to obtain the county-wide emission estimates shown in Table 2.8.

Baseline projection emissions were determined using population as the projection factor. The 1979 SIP requires a 70% control of emission from perchloroethylene dry cleaning solvents by 1987. The 1982 SIP requires emission reductions from dry cleaning operations using petroleum solvents. The proposed control efficiency is 70%.

TABLE 2.8. SUMMARY OF COMMERCIAL AND COIN OPERATED DRY CLEANING EMISSIONS

County	Employment[a] in 7215 and 7216 SIC Codes	Type of Cleaning Solvent	Reactive VOC Emissions (kg/day)		
			Base Year	Baseline Projection	Control Strategy
A	611	Petroleum	351	372	112
		Perchloroethylene	829	265	265
B	404	Petroleum	213	216	66
		Perchloroethylene	564	174	174
C	588	Petroleum	307	321	98
		Perchloroethylene	819	255	255
D	328	Petroleum	171	181	56
		Perchloroethylene	456	146	146

[a] Reference: County Business Patterns 1980, Bureau of Census, U.S. Department of Commerce.

Table 2.8 summarizes the emissions from commercial and coin operated dry cleaning operations. No seasonal adjustment was made based on the survey results. Emissions were found to occur Monday through Friday, so that annual emissions were divided by 260 rather than 365 to estimate weekday emissions.

2.3.3 Graphic Arts

An emission factor of 0.8 lb/capita/year is recommended for estimating reactive VOC emissions for small graphic arts facilities which emit less than 100 tpy. Only one graphic arts facility, located in County C, was identified as emitting more than 100 tpy of VOC. There were several smaller graphic arts facilities in the point source inventory that had emission rates less than 100 tpy. The emissions from these sources were subtracted from the per capita derived emission totals. For example, six small graphic arts facilities are located in County A, with emission rates of 10, 15, 27, 30, 35, and 51 tpy, so that:

$$\text{Total Emissions} = \text{Per Capita Factor} \times \text{Population} - \text{Small Point Source Emissions}$$

$$= \frac{0.8 \text{ lbs}}{\text{person/year}} \times 675{,}048 \text{ people} - 168 \text{ tpy}$$

$$= 270 \text{ tpy} - 168 \text{ tpy} = 102 \text{ tpy}$$

Similarly, emissions from small graphic arts point sources in Counties B, C, and D were 61, 20, and 46 tpy, respectively, and were subtracted from the per capita derived emissions. All VOC are reactive, and no seasonal adjustment was made. Emissions were assumed to occur uniformly Monday through Saturday during the week. Emissions were projected to increase with the growth in population. Since the control efficiencies defined in the SIPs differ for different types of printing, the percentage of printing done by the four methods of printing were estimated using the CTG documents. The breakdown is:

	% of Facilities	% Reduction in 1979 SIP	% Reduction in 1982 SIP
Rotogravure	40	65	0
Flexographic	15	60	0
Offset	35	0	60
Letterpress	10	0	60

Table 2.9 summarizes the emissions from small graphic arts facilities.

2.3.4 Cutback Asphalt Paving

VOC emissions result from cutback asphalt paving when petroleum distillate solvents or diluents used to liquify the asphalt cement evaporate at both the job site and the mixing plant. The state transportation department supplied data on the quantity of each type of cutback applied in each of the four counties during 1980. However, the diluent content

TABLE 2.9. EMISSIONS FROM SMALL (LESS THAN 100 TPY) GRAPHIC ARTS FACILITIES

County	Type of Printing	Reactive VOC Emissions (kg/day)		
		Base Year	Baseline Projection	Control Strategy
A	Rotogravure	119	44	44
	Flexographic	44	19	19
	Offset	104	110	44
	Letterpress	29	30	13
		296	203	120
B	Rotogravure	70	26	26
	Flexographic	26	10	10
	Offset	61	63	24
	Letterpress	18	18	7
		175	117	67
C	Rotogravure	262	96	96
	Flexographic	98	41	41
	Offset	230	239	96
	Letterpress	65	68	27
		655	444	260
D	Rotogravure	222	82	82
	Flexographic	83	35	35
	Offset	195	206	83
	Letterpress	56	60	23
		556	383	223

of each type was not known. Volume I recommends using default values of 25, 35, and 45 percent by volume for slow cure, medium cure, and rapid cure cutbacks, respectively. Using these default values and Table 4.5-1 of AP-42, the evaporative VOC emissions from cutback asphalt paving were calculated for each county. Table 2.10 lists the 1980 cutback asphalt use and corresponding VOC emissions for each county in the study area. According to Volume I, all VOC emissions from cutback asphalt are photochemically reactive. All cutback emissions were assumed to occur during the months of application, primarily March through November in Ozoneville. The 1979 SIP abolished the use of cutback asphalts in the study area. Cutback asphalts will be replaced by emulsified asphalts. Therefore, VOC emissions from cutback asphalt paving will be zero during the projection year.

2.3.5 Commercial/Consumer Solvent Use

Volume I recommends using a factor of 6.3 lb/capita/yr for estimating reactive VOC emissions from this source category.

Emissions from this category were projected based upon 1980-1987 population growth factors. Table 2.11 summarizes VOC emissions from commercial/consumer solvent use by county for the base year and projection year.

2.4 OTHER MISCELLANEOUS SOURCES

2.4.1 Fuel Combustion

This source category includes small boilers, furnaces, heaters, and other heating units too small to be considered point sources. Four types of fuels are used in the Ozoneville study area: bituminous coal, oil, natural gas, and wood. Area source fuel use can be categorized into three user types: residential, commercial/institutional, and light industrial. Both VOC and NO_x are emitted when fuels are combusted. The fuel combustion category will be discussed by user type.

Fuels are combusted in residences for space heating, water heating, and cooking. Space heating would not take place during the ozone season. Therefore, residential coal and wood use was not included in the area source inventory. Oil use for residential water heating is negligible in Ozoneville. The major residential fuel used is natural gas. Local fuel distributors were able to supply residential natural gas usage for each county for 1980. Emission factors for hydrocarbons and NO_x from domestic natural gas combustion can be found in Table 1.4-1 of AP-42. A factor of 8 lbs/10^6 cubic feet is given for hydrocarbons. According to the VOC Species Manual, only 40% by weight of the VOC emissions from natural gas combustion are reactive. Therefore, an emission factor of 3.2 lbs/10^6 cubic feet was used to estimate reactive VOC emissions from residential natural gas combustion. The AP-42 emission factor of 80 lbs/10^6 cubic feet was used to estimate NO_x emissions. EPA-450/4-80-016 recommends apportioning 7% of the annual total to the June through August period. Residential natural gas usage was projected according to 1987 population estimates obtained from ORPA. Table 2.12 lists reactive VOC and NO_x emissions from residential natural gas combustion by county for the base year and the two projection year inventories.

TABLE 2.10. 1980 CUTBACK ASPHALT USAGE AND CORRESPONDING VOC EMISSIONS

County	Rapid Cure Usage (kg)	VOC Emissions (kg/day)	Medium Cure Usage (kg)	VOC Emissions (kg/day)	Slow Cure Usage (kg)	VOC Emissions (kg/day)	Total VOC Emissions (kg/day)
A	51,709	60	361,965	264	103,419	19	343
B	41,458	48	290,207	212	82,916	15	275
C	31,298	36	219,084	160	62,595	12	208
D	50,258	59	351,804	257	100,516	19	335

TABLE 2.11. VOC EMISSIONS FROM COMMERCIAL/CONSUMER SOLVENT USE

County	1980 Population	Base Year Emissions (kg/day)	Population Growth Factor	Baseline Projection Emissions (kg/day)	Control Strategy Emissions (kg/day)
A	675,000	5,285	1.06	5,602	5,602
B	301,700	2,362	1.03	2,433	2,433
C	612,400	4,795	1.04	4,987	4,987
D	472,800	3,702	1.06	3,924	3,924

TABLE 2.12. REACTIVE VOC AND NO_x EMISSIONS FROM RESIDENTIAL NATURAL GAS COMBUSTION, OZONEVILLE STUDY AREA

County	1980 Use (10^6 ft^3)	Base Year Emissions (kg/day)		Population Growth Factor	Baseline Projection Emissions (kg/day)		Control Strategy Emissions (kg/day)	
		VOC	NO_x		VOC	NO_x	VOC	NO_x
A	8,490	10	236	1.06	10	251	10	251
B	3,820	4	106	1.03	4	109	4	109
C	7,680	9	214	1.04	9	223	9	223
D	6,000	7	167	1.06	7	177	7	177

Retail and wholesale stores, schools, hospitals, government and public buildings, churches, and restaurants are all commercial/institutional establishments. Fuels are combusted in commercial/institutional establishments for space heating, cooling, water heating, and cooking. Since space heating would not occur during the ozone season, commercial/institutional coal and wood use were not included in the area source inventory. Oil use for water heating in Ozoneville is believed to be negligible. Local fuel distributors were able to supply total commercial/institutional natural gas usage by county for 1980. The commercial/ institutional natural gas usage in the point source inventory was subtracted from the total to determine the area source natural gas usage. The emission factor of 3.2 lbs/10^6 cubic feet used to estimate reactive VOC emissions from residential natural gas combustion was used for commercial/institutional natural gas combustion as well. Table 1.4-1 of AP-42 lists a factor of 120 lbs/10^6 cubic feet for NO_x emissions. EPA-450/4-80-016 recommends 15% of annual commercial/institutional fuel use occurs during ozone season. Fuel combustion is assumed to occur uniformly Monday through Saturday.

Commercial/institutional fuel use was projected according to 1987 commercial/institutional employment estimates obtained from ORPA. Table 2.13 lists reactive VOC and NO_x emissions from commercial/institutional natural gas combustion by county for the base year and the two projection year inventories.

Light industrial fuel combustion area sources are those manufacturing industries too small to be included in the point source inventory. Total industrial fuel usage values were obtained for bituminous coal, residual and distillate oil, and natural gas. The State Department of Commerce supplied figures for the total amount of coal and oil purchased by county manufacturers in 1980. Local fuel distributors were contacted to obtain total industrial natural gas usage. Point source inventory industrial fuel usage was subtracted from the totals to obtain area source industrial fuel usage. Volume I states that area source industrial wood use is usually ignored and neither coke nor process gas will be used by establishments which are classed as area sources. No seasonal or weekday adjustments were assumed in estimating weekday emissions. Light industrial fuel use was projected according to 1987 manufacturing employment estimates obtained from ORPA.

Table 1.1-2 of AP-42 lists emission factors for organics, aldehydes, and NO_x emissions from bituminous coal combustion in general industrial boilers. The VOC Species Manual does not list percentages of nonreactive VOC for coal combustion. Therefore, the Regional Air Pollution Study (RAPS) hydrocarbon classification for fuel combustion was used. No species split was available specifically for coal combustion. RAPS gives a reactive percentage of 34% by weight for fuel combustion. AP-42 gives an organics emission factor of 1 lb/ton coal burned and an aldehydes emission factor of 0.005 lb/ton. Therefore, the reactive VOC emission factor used for light industrial coal combustion was 0.345 lb/ton of coal burned. The AP-42 NO_x emission factor of 15 lb/ton of coal burned was used to estimate NO_x emissions from light industrial coal combustion. Table 2.14 lists reactive VOC and NO_x emissions from light industrial coal combustion by county for the base year and the two projection year inventories.

TABLE 2.13. REACTIVE VOC AND NO_x EMISSIONS FROM COMMERCIAL/INSTITUTIONAL NATURAL GAS COMBUSTION, OZONEVILLE STUDY AREA

County	1980 Use[a] (10^6 ft^3)	Base Year Emissions (kg/day)		C/I Employment Growth Factor	Baseline Projection Emissions (kg/day)		Control Strategy Emissions (kg/day)	
		VOC	NO_x		VOC	NO_x	VOC	NO_x
A	6,170	18	644	1.08	19	696	19	696
B	1,710	5	178	1.05	5	188	5	188
C	3,820	10	399	1.12	12	447	12	447
D	2,670	8	279	1.04	8	290	8	290

[a] These figures exclude point source natural gas fuel use.

TABLE 2.14. REACTIVE VOC AND NO_x EMISSIONS FROM LIGHT INDUSTRIAL COAL COMBUSTION, OZONEVILLE STUDY AREA

County	1980 Use[a] (tons)	Base Year Emissions (kg/day)		Manufacturing Employment Growth Factor	Baseline Projection Emissions (kg/day)		Control Strategy Emissions (kg/day)	
		VOC	NO_x		VOC	NO_x	VOC	NO_x
A	19,900	9	371	1.02	9	378	9	378
B	10,500	5	196	1.01	5	198	5	198
C	13,800	6	257	1.02	6	262	6	262
D	15,200	7	283	1.01	7	286	7	286

[a] These figures exclude point source use.

Table 1.3-1 of AP-42 lists emission factors for hydrocarbons and NO_x emissions from residual and distillate fuel oil combustion in industrial boilers. For hydrocarbons, a factor of 1 lb/1000 gallons burned is listed for both residual and distillate oil. According to the VOC Species Manual, 89% by weight of the VOC emissions from residual oil combustion are reactive while 100% of the VOC emissions from distillate oil combustion are reactive. Consequently, a reactive VOC emission factor of 0.89 lb/1000 gallons was used to estimate reactive VOC emissions from light industrial residual oil combustion. A reactive VOC emission factor of 1 lb/1000 gallons was used to estimate reactive VOC emissions from light industrial distillate oil combustion. The NO_x emission factors given in Table 1.3-1 of AP-42, 60 lb/1000 gallons and 22 lbs/1000 gallons for industrial residual and distillate oil combustion respectively, were used to estimate NO_x emissions. Table 2.15 lists reactive VOC and NO_x emissions from light industrial residual oil combustion by county for the base year and the two projection year inventories. Table 2.16 does the same for light industrial distillate oil combustion.

Table 1.4-1 of AP-42 lists hydrocarbon and NO_x emission factors for natural gas combustion in industrial process boilers. A factor of 3 lb/10^6 cubic feet is given for hydrocarbons. According to the VOC Species Manual, 40% by weight of the VOC emissions from natural gas combustion are reactive. Consequently, a reactive VOC emission factor of 1.2 lbs/10^6 ft^3 was used to calculate reactive VOC emissions from light industrial natural gas combustion. The average of the two NO_x emission factors given in Table 1.4-1 of AP-42, i.e., 175 lb/10^6 ft^3, was used to calculate NO_x emissions from light industrial natural gas combustion. Table 2.17 lists reactive VOC and NO_x emissions from light industrial natural gas combustion by county for the base year and the two projection year inventories.

Table 2.18 summarizes the emissions data given in Tables 2.12 through 2.17. It shows the total reactive VOC and NO_x emissions from area source fuel combustion by county for the base year and the two projection year inventories.

2.4.2 Solid Waste Disposal

The area source solid waste disposal category includes on-site refuse disposal by residential, commercial/institutional, and industrial sources. On-site incineration and open burning are the two solid waste disposal methods inventoried as area sources. Both VOC and NO_x are emitted.

No on-site incinerators are included in the point source inventory. The factors in Volume I for estimating tons of solid waste burned by on-site incineration are dated; therefore, officials of the Ozoneville Municipal Trash Collection Agency were queried to obtain updated factors. Table 2.19 lists these factors along with the base year estimates of solid waste by county generated from these factors. Table 2.1-1 of AP-42 gives emission factors for hydrocarbon and NO_x emissions from industrial/commercial single chamber incinerators. The hydrocarbon emission factor is 15 lbs/ton of waste burned. According to RAPS, 58% of the hydrocarbon emissions from waste incineration are reactive. Therefore,

TABLE 2.15. REACTIVE VOC AND NO_x EMISSIONS FROM LIGHT INDUSTRIAL RESIDUAL OIL COMBUSTION, OZONEVILLE STUDY AREA

County	1980 Use[a] (10^3 gal)	Base Year Emissions (kg/day) VOC	Base Year Emissions (kg/day) NO_x	Manufacturing Employment Growth Factor	Baseline Projection Emissions (kg/day) VOC	Baseline Projection Emissions (kg/day) NO_x	Control Strategy Emissions (kg/day) VOC	Control Strategy Emissions (kg/day) NO_x
A	50,580	56	3,771	1.02	57	3,846	57	3,846
B	16,800	19	1,253	1.01	19	1,266	19	1,266
C	24,290	27	1,811	1.02	28	1,847	28	1,847
D	22,590	25	1,684	1.01	25	1,701	25	1,701

[a] These figures exclude point source use.

TABLE 2.16. REACTIVE VOC AND NO_x EMISSIONS FROM LIGHT INDUSTRIAL DISTILLATE OIL COMBUSTION, OZONEVILLE STUDY AREA

County	1980 Use[a] (10^3 gal)	Base Year Emissions (kg/day)		Manufacturing Employment Growth Factor	Baseline Projection Emissions (kg/day)		Control Strategy Emissions (kg/day)	
		VOC	NO_x		VOC	NO_x	VOC	NO_x
A	18,560	23	507	1.02	23	517	23	517
B	3,600	4	98	1.01	4	99	4	99
C	6,180	8	169	1.02	8	172	8	172
D	5,860	7	160	1.01	7	162	7	162

[a] These figures exclude point source use.

TABLE 2.17. REACTIVE VOC AND NO_x EMISSIONS FROM LIGHT INDUSTRIAL NATURAL GAS COMBUSTION, OZONEVILLE STUDY AREA

County	1980 Use[a] (10^6 ft^3)	Base Year Emissions (kg/day)		Manufacturing Employment Growth Factor	Baseline Projection Emissions (kg/day)		Control Strategy Emissions (kg/day)	
		VOC	NO_x		VOC	NO_x	VOC	NO_x
A	8,200	12	1,783	1.02	12	1,819	12	1,819
B	2,800	4	609	1.01	4	615	4	615
C	4,260	6	926	1.02	6	945	6	945
D	3,620	5	787	1.01	5	795	5	795

[a] These figures exclude point source use.

TABLE 2.18. TOTAL REACTIVE VOC AND NO_x EMISSIONS FROM FUEL COMBUSTION, OZONEVILLE STUDY AREA

County	Base Year Emissions (kg/day)		Baseline Projection Emissions (kg/day)		Control Strategy Emissions (kg/day)	
	VOC	NO_x	VOC	NO_x	VOC	NO_x
A	128	7,391	130	7,507	130	7,507
B	41	2,440	41	2,475	41	2,475
C	66	3,776	69	3,896	69	3,896
D	59	3,360	58	3,411	58	3,411

TABLE 2.19. ESTIMATES OF BASE YEAR SOLID WASTE BURNED IN ON-SITE INCINERATION

County	Residential Solid Waste Factor (tons/1000 pop.)	Residential Solid Waste (tons)	C/I Solid Waste Factor (tons/1000 pop.)	C/I Solid Waste (tons)	Industrial Solid Waste Factor (tons/ 1000 mfg. employ.)	Industrial Solid Waste (tons)
A	57	38,475	69	46,575	130	15,340
B	57	17,214	69	20,838	130	5,330
C	57	34,884	69	42,228	130	7,930
D	57	26,961	69	32,637	130	7,540

a reactive VOC emission factor of 8.7 lbs/ton was used in the analysis. The NO_x emission factor of 2 lb/ton given in Table 2.1-1 of AP-42 was used as well. It was determined there are no seasonal or weekday variations in on-site incineration in the Ozoneville study area. On-site incineration was projected according to population. Table 2.20 lists reactive VOC and NO_x emissions from onsite incineration by county for the base year and the two projection year inventories.

An Ozoneville city ordinance prohibits open burning within the city limits. Open burning permits are required from county health departments for any open burning outside the city limits. Each of the four county health departments were contacted to obtain estimates of tonnage of nonagricultural material burned during the ozone season. These tonnages are shown in Table 2.21. Table 2.4-1 of AP-42 gives organics and NO_x emission factors for open burning of nonagricultural material. Using the organics factor found in AP-42 and the 58% reactive value for waste incineration given in RAPS, a reactive VOC emission factor of 17.4 lbs/ton burned was determined. The NO_x emission factor of 6 lb/ton given in Table 2.4-1 of AP-42 was used to calculate NO_x emissions. Open burning activity was projected according to population. Table 2.21 lists reactive VOC and NO_x emissions from open burning by county for the base year and the two projection year inventories.

2.4.3 Forest, Agricultural, and Other Open Burning

This area source category includes emissions from forest fires, slash burning and agricultural field burning, and structure fires. Although they are often intermittent in nature, many of these sources can produce large quantities of air pollutant emissions.

The state department of forestry was able to provide data on acres of land consumed by forest fires during the summer of 1980 for each county. However, they could not estimate fuel loadings for the counties. Therefore, the fuel loading factor given in Table 11.1-1 of AP-42 was used to calculate the tons of material burned. AP-42 suggests a total hydrocarbons emission factor of 24 lb/ton. The VOC Species Manual reports that approximately 80% of the hydrocarbon emissions from forest fires are reactive. Thus, a reactive VOC emission factor of 19.2 lb/ton was used. AP-42 recommends a NO_x emission factor of 4 lb/ton. According to ORPA, no development is expected in those areas of the four counties which experienced forest fires during the summer of 1980. Therefore, the tons of material consumed by forest fires in the projection year were assumed to be the same as the base year. Table 2.22 lists reactive VOC and NO_x emissions from forest fires by county for the base year and the two projection year inventories.

Slash burning is done in County B only, according to the State Department of Forestry, who estimated that approximately ten acres of land were slash burned during the 1980 ozone season. Volume I recommends using a factor of 75 tons slash per acre. The emission factors used for forest fires were used to estimate reactive VOC and NO_x emissions from slash burning. Slash burning activity was assumed to be the same for the projection year as the base year.

TABLE 2.20. REACTIVE VOC AND NO_x EMISSIONS FROM ON-SITE INCINERATION, OZONEVILLE STUDY AREA

County	Total Base Year On-Site Incineration (tons)	Base Year Emissions (kg/day)		Population Growth Factor	Baseline Projection Emissions (kg/day)		Control Strategy Emissions (kg/day)	
		VOC	NO_x		VOC	NO_x	VOC	NO_x
A	100,390	1,085	249	1.06	1,150	264	1,150	264
B	43,382	469	108	1.03	483	111	483	111
C	85,042	919	211	1.04	956	219	956	219
D	67,138	726	167	1.06	770	177	770	177

TABLE 2.21. REACTIVE VOC AND NO_x EMISSIONS FROM OPEN BURNING, OZONEVILLE STUDY AREA

County	Estimated Base Year Ozone Season Nonagricultural Open Burning (tons)	Base Year Emissions (kg/day)		Population Growth Factor	Baseline Projection Emissions (kg/day)		Control Strategy Emissions (kg/day)	
		VOC	NO_x		VOC	NO_x	VOC	NO_x
A	9,300	816	281	1.06	865	298	865	298
B	5,200	456	157	1.03	470	162	470	162
C	7,900	693	239	1.04	721	249	721	249
D	6,400	561	194	1.06	595	206	595	206

TABLE 2.22. REACTIVE VOC AND NO_x EMISSIONS FROM FOREST FIRES, OZONEVILLE STUDY AREA

County	Forest Material Burned During the Base Year Ozone Season (tons)	Base Year Emissions (kg/day)		Baseline Projection Emissions (kg/day)		Control Strategy Emissions (kg/day)	
		VOC	NO_x	VOC	NO_x	VOC	NO_x
A	99	10	2	10	2	10	2
B	297	29	6	29	6	29	6
C	0	0	0	0	0	0	0
D	77	7	2	7	2	7	2

The county agricultural extension services were contacted to obtain estimates of the acreage of fields which were burnt for cleaning purposes during the summer of 1980. In addition, county fire departments were contacted to obtain estimates of field acreage claimed by accidental fires. Based upon conversations with the county agricultural extension agents, it was assumed that 80 percent of the acreage burned was covered with weeds while the remaining 20% was covered by field crops. Using the fuel loading factors found in Table 2.4-2 of AP-42 for unspecified field crops and weeds, the quantity of agricultural material burnt in each county during the 1980 ozone season was calculated:

- o County A - 540 tons
- o County B - 1302 tons
- o County C - 120 tons
- o County D - 1000 tons

Table 2.4-2 of AP-42 lists an organics emission factor of 23 lb/ton for unspecified field crops and 12 lb/ton for unspecified weeds. The weighted emission factor for organics then is 14 lb/ton. Table 5-01-002 of the VOC Species Manual shows that 100% of the VOC emissions from agricultural/landscape/pruning open burning are reactive. Thus, the 14 lb/ton emission factor was used to calculate reactive VOC emissions. Table 2.4-2 of AP-42 does not give an emission factor for NO_x. AP-42 states that "the relatively low temperatures associated with open burning . . . suppress the emissions of nitrogen oxides."

The nature of agricultural burning makes projections almost impossible. The county agricultural extension agents do not expect deliberate agricultural burning to increase. Therefore, the quantity of agricultural material burned during the projection year was assumed to be the same as the base year. Table 2.23 lists reactive VOC and NO_x emissions from slash burning and agricultural field burning by county for the base and projection years.

The county fire marshals were contacted to obtain data on the number of structural fires during the 1980 ozone season. AP-42 does not specifically address structural fire emission factors but the Aerometric and Emissions Reporting System (AEROS) does. AEROS reports a NO_x emission factor of 17 lbs/structural fire. The hydrocarbon emission factor is 107 lbs/structural fire. RAPS waste incineration species split lists a reactive percentage of 58%. This percentage was used along with the AEROS emission factor to develop a reactive VOC emission factor of 62 lbs/structural fire. Structural fires were projected according to population. Table 2.24 lists reactive VOC and NO_x emissions from structural fires by county for the base year and the two projection year inventories.

2.4.4 Pesticide Application

Agricultural and urban pesticide use were investigated to determine VOC emissions from this area source category. Pesticide use in homes and gardens is included in the commercial/consumer solvent use category.

The state department of agriculture was contacted to determine the quantities and types of pesticides applied in the study area during the

TABLE 2.23. REACTIVE VOC AND NO_x EMISSIONS FROM SLASH AND AGRICULTURAL FIELD BURNING, OZONEVILLE STUDY AREA

County	Base Year Emissions (kg/day)		Baseline Projection Emissions (kg/day)		Control Strategy Emissions (kg/day)	
	VOC	NO_x	VOC	NO_x	VOC	NO_x
A	38	0	38	0	38	0
B	165	15	165	15	165	15
C	8	0	8	0	8	0
D	71	0	71	0	71	0

TABLE 2.24. REACTIVE VOC AND NO_x EMISSIONS FROM STRUCTURAL FIRES, OZONEVILLE STUDY AREA

County	Base Year Structural Fires	Base Year Emissions (kg/day)		Population Growth Factor	Baseline Projection Emissions (kg/day)		Control Strategy Emissions (kg/day)	
		VOC	NO_x		VOC	NO_x	VOC	NO_x
A	964	301	83	1.06	319	88	319	88
B	450	141	39	1.03	145	40	145	40
C	733	229	63	1.04	238	66	238	66
D	870	272	75	1.06	288	80	288	80

ozone season. The local public health department provided estimates of pesticide use in urban areas. The quantity of inorganic pesticides was eliminated from the total pesticide usage. Then, as suggested in Volume I, the remaining synthetic and nonsynthetic total was multiplied by a factor of 0.9 to estimate the total amount that evaporates and can be considered photochemically reactive.

The state department of agriculture estimated 1% annual growth rate in agricultural pesticide use for the study area. It was assumed that urban pesticide use would grow at the same rate. No controls on pesticide application are established in the 1979 or 1982 SIPs. Table 2.25 lists estimates of reactive emissions from pesticide application for the four county study areas during a typical day during the ozone season in the base year and two projection year inventories.

2.4.5 Stationary Internal Combustion Engines

This source category includes exhaust emissions from large stationary internal combustion engines which are not entered on the point source file. Turbines used by utilities for generating electricity are in the point source inventory. Ozoneville Electric, which provides natural gas to the four external counties, operates pumping stations along the main natural gas pipeline. These are not included in the point source inventory.

Two pumping stations along the main pipeline lie in the Ozoneville study. One station is located in County B. The other is in County C. Ozoneville Electric reported that each station has five reciprocating natural gas compressors rated at about 1800 Hp which operate continuously. Assuming 90 days of operation during the ozone season, each compressor would run 3888 x 10^3 Hp-hr. The NO_x emission factor of 24 lb/10^3 Hp-hr listed in Table 3.3.2-1 of AP-42 was used to calculate NO_x emissions during the ozone season. A hydrocarbon emission factor of 9.7 lb/10^3 Hp-hr was listed in Table 3.3.2-1. AP-42 states that up to 10% of these hydrocarbons are nonmethane. Therefore, a reactive VOC emission factor of 1 lb/10^3 Hp-hr was used to calculate reactive VOC emissions during the ozone season. Ozoneville Electric does not plan to add any new compressors before 1987. Therefore, the emissions from this category during the projection year were assumed to be equal to those during the base year. Table 2.26 lists reactive VOC and NO_x emissions from stationary internal combustion engines by county for the base year and two projection year inventories.

2.5 NONHIGHWAY MOBILE SOURCES

2.5.1 Agricultural Equipment

This source category includes exhaust emissions from farm tractors and other self-propelled agricultural equipment. Space heating and commodity drying are not included. Emissions are based on the quantity of diesel fuel and gasoline consumed.

TABLE 2.25. REACTIVE VOC EMISSIONS FROM PESTICIDE APPLICATION, OZONEVILLE STUDY AREA

County	1980 Organic Pesticide Usage (kg)	Base Year Emissions (kg/day)	Pesticide Use Growth Factor	Baseline Projection Emissions (kg/day)	Control Strategy Emissions (kg/day)
A	78,900	195	1.07	209	209
B	237,700	586	1.07	628	628
C	11,800	29	1.07	31	31
D	144,200	356	1.07	382	382

TABLE 2.26. REACTIVE VOC AND NO_x EMISSIONS FROM STATIONARY INTERNAL COMBUSTION ENGINES, OZONEVILLE STUDY AREA

County	Total Base Year Ozone Season Operation (10^3 Hp-hr)	Base Year Emissions (kg/day)		Baseline Projection Emissions (kg/day)		Control Strategy Emissions (kg/day)	
		VOC	NO_x	VOC	NO_x	VOC	NO_x
A	0	0	0	0	0	0	0
B	19,440	98	2,351	98	2,351	98	2,351
C	19,440	98	2,351	98	2,351	98	2,351
D	0	0	0	0	0	0	0

The number of tractors and other farm equipment -- combines, balers, and harvesters -- was obtained from the 1979 Census of Agriculture. Estimates of the annual hours of operation for each vehicle type, fuel consumption rate, and gasoline-deisel split were obtained from Volume I. The product of number of vehicles, hours of operation, and fuel consumption rate is the fuel consumed.

Emission factors were broken down by type of machinery. Table 2.27 shows all factors used, which were taken directly from AP-42. From the VOC Species Manual, it was determined that 21.5% of the VOC emission from the gasoline-powered equipment and 9.7% of the diesel fuel emissions were unreactive. The projection factor, agricultural employment, is 1.10 for Counties A, B, and D and 0.95 for County C. The emission inventory is summarized in Table 2.28.

2.5.2 Construction Equipment

This source category includes off-highway exhaust emissions from construction equipment using diesel or gasoline fuel. Emissions are based on quantity of fuel consumed. Total off-highway diesel fuel used in the state was given in the Energy Data Reports for 1980. However, this included agricultural uses as well as construction.

The total number of tractors in the state for the year 1979 was given in the 1979 State Census of Agriculture. A 1980 value was extrapolated from these figures giving 121,075 tractors of which 65% (78,698) were assumed to be gasoline and 30% (36,322) were assumed to be diesel powered. Using average values for operational use of 1,460 gal/yr of diesel fuel per tractor, the state total amount of diesel fuel used in base year 1976 by agricultural tractors was calculated to be 53,030,000 gallons. This was subtracted from the off-highway diesel fuel total for the state (109,662,000 gallons) and the resulting construction component (56,632,000 gallons) was disaggregated to the counties according to heavy construction contractors (SIC 16) listed in County Business Patterns 1980. These calculations and the county fuel use obtained from them are given in Table 2.29. Gasoline totals were obtained by using the suggested 10% of diesel consumption suggested in Volume I.

Baseline projection emissions for 1987 were determined by changes in construction employment for each county. This information was also found in County Business Patterns 1980. The emission factors for both inventory years were calculated from AP-42 by weighting the emission factor for each type of equipment in accordance with its relative percent use. Gasoline equipment and diesel equipment emission factors were calculated separately.

The VOC Species Manual was used to determine the percentage of VOC emissions that were nonreactive. For diesel-powered construction equipment, Table 6-07-021 gave this figure as 8.9%. The component split for gasoline-powered vehicles (KVB Table 6-06-0210) listed 21.5% of VOC emissions as unreactive. The inventory is summarized in Table 2.30.

2.5.3 Lawn and Garden Equipment

This source category includes off-highway exhaust emissions from small gasoline engines of the type that would typically have a residential

TABLE 2.27. AGRICULTURAL EQUIPMENT EMISSION FACTORS

Pollutant	Emission Factors (lb/1000 gallons fuel) Gasoline Tractor	 Non-Tractor	 Diesel Fuel Tractor	 Non-Tractor
Exhaust VOC	125	135	60.7	57.1
Crankcase VOC	25.1	27.1	---	---
Evaporative VOC[a]	34.4	3.53	---	---
NO_x	151	98.5	335	307
Aldehydes	6.84	4.14	12.1	10.2

[a] Units expressed as lbs/unit-year.

TABLE 2.28. AGRICULTURAL EQUIPMENT EMISSIONS

County	Fuel Type	Amount of Fuel Used (gal/yr)	Reactive VOC Emissions (kg/day)			NO_x Emissions (kg/day)		
			Base Year	Baseline Projection	Control Strategy	Base Year	Baseline Projection	Control Strategy
A	Tractor Gasoline	679,000	157	173	173	128	140	140
	Non-Tractor Gasoline	29,000	5	6	6	4	4	4
	Tractor Diesel	690,000	56	62	62	288	316	316
	Non-Tractor Diesel	33,000	2	2	2	13	14	14
			220	243	243	433	474	474
B	Tractor Gasoline	1,626,000	376	414	414	305	336	336
	Non-Tractor Gasoline	64,000	10	11	11	8	9	9
	Tractor Diesel	1,653,000	135	149	149	689	758	758
	Non-Tractor Diesel	73,000	6	7	7	28	31	31
			527	581	581	1,030	1,134	1,134
C	Tractor Gasoline	78,000	18	17	17	15	14	14
	Non-Tractor Gasoline	2,000	0	0	0	0	0	0
	Tractor Diesel	80,000	7	7	7	33	31	31
	Non-Tractor Diesel	1,800	0	0	0	1	1	1
			25	24	24	49	46	46
D	Tractor Gasoline	914,000	193	212	212	172	189	189
	Non-Tractor Gasoline	39,000	6	7	7	5	5	5
	Tractor Diesel	929,000	76	84	84	387	426	426
	Non-Tractor Diesel	48,000	4	4	4	18	20	20
			279	307	307	582	640	640

TABLE 2.29. FUEL USED BY CONSTRUCTION EQUIPMENT IN BASE YEAR 1980[a]

County	Heavy Construction Employment[b]	Diesel Fuel Used (gal)	Gasoline Used[c] (gal)
A	1,874	2,817,000	281,700
B	868	1,305,000	130,500
C	981	1,476,000	147,600
D	1,091	1,634,000	163,400

[a] State total to apportion: 56,632,000.
[b] State total SIC 16 employment: 37,675.
[c] Assumed to be 10% of diesel use.

TABLE 2.30. CONSTRUCTION EQUIPMENT EMISSIONS

County	Fuel Type	Emission Factor (lbs/10^3 gals)		Reactive VOC Emissions (kg/day)			NO_x Emissions (kg/day)		
		VOC	NO_x	Base Year	Baseline Projection	Control Strategy	Base Year	Baseline Projection	Control Strategy
A	Gasoline	151.6	36.6	42	44	44	13	14	14
	Diesel	108.7	422.2	347	364	364	1,479	1,553	1,553
B	Gasoline	151.6	36.6	19	20	20	6	6	6
	Diesel	108.7	422.2	161	169	169	685	719	719
C	Gasoline	151.6	36.6	22	24	24	7	8	8
	Diesel	108.7	422.2	182	200	202	775	852	852
D	Gasoline	151.6	36.6	24	26	26	7	8	8
	Diesel	108.7	422.2	201	221	221	858	944	944

application; i.e., lawn mowers, small electric generators, garden tractors, etc. Emissions are based on the quantity of fuel consumed, which is the activity level.

The per capita fuel consumption is the product of the average consumption per unit per year, the average number of units per capita, and the population. The first parameter, average annual fuel consumption per unit, can be calculated using data from AP-42. The national average is 12.7 gallons per unit year, which should be adjusted according to the number of non-freezing days as outlined in Volume I. The number expressing the ratio of non-freezing days in the Ozoneville AQCR to the national average is 256/250; therefore, the adjusted consumption rate is 13.0 gallons per unit per year. AP-42 cites the national average of 0.21 units per capita, which should be adjusted for the dwelling unit vs. structure distribution. According to the Statistical Abstract of the United States, 1977, 26% of all structures are multiple-units. The 0.21 units per capita figure was, therefore, adjusted linearly according to how the multiple-units figures for the individual counties compared to the national average. In this manner, those areas with a greater percentage of single unit structures would be allocated more units per capita. These values are shown in Table 2.31. Lawn and garden equipment fuel use is assumed to occur uniformly from March through November.

The emission factors were taken from AP-42. They are a weighted average of the factors for four-stroke lawn and garden engines, four-stroke miscellaneous engines, and two-stroke lawn and garden engines. They are: 448 lbs per thousand gallons for volatile organic compounds, and 41.9 lbs per thousand gallons for oxides of nitrogen. As per Table 6-06-021D in the VOC Species Manual, 21.5% of the VOC is nonreactive.

The activity parameters for this category were projected according to population. Table 2.32 summarizes the emission inventory for Lawn and Garden Equipment.

2.5.4 Railroad Locomotives

This source category includes exhaust emissions from diesel locomotive engines, both line-haul and switch engines, as well as emissions from auxiliary equipment. Emissions are based on the quantity of diesel fuel consumed.

The 1980 railroad fuel use in each county, shown in Table 2.33, was obtained from the State Department of Environmental Resources (DER). This information had been derived from the 1980 Annual Report of the Public Utility Commission (PUC).

Projection year rail locomotive activity was based on conversations with the major railway companies. Although one of the minor freight companies expressed an interest in adding a new shift by 1987, 1980 activity levels were assumed to remain the same. Verification was found in the OBERS projections from the U.S. Department of Commerce. This reference predicts no change in railroad earnings for the Ozoneville area until 1990, when a gradual decrease in earnings will begin.

TABLE 2.31. FUEL CONSUMPTION BY SMALL GASOLINE ENGINES IN BASE YEAR 1980

County	Adjusted Consumption Per Unit Per Year (gal)	Number of Units Per Capita	1976 Population	Annual Consumption
A	13	0.221	675,048	1,939,413
B	13	0.231	301,727	906,086
C	13	0.244	612,400	1,942,533
D	13	0.255	472,803	1,567,342

TABLE 2.32. LAWN AND GARDEN EQUIPMENT EMISSIONS

	Reactive VOC Emissions (kg/day)			NO_x Emissions (kg/day)		
County	Base Year	Baseline Projection	Control Strategy	Base Year	Baseline Projection	Control Strategy
A	1,131	1,199	1,199	135	143	143
B	528	544	544	63	65	65
C	1,132	1,177	1,177	135	140	140
D	913	968	968	109	116	116

TABLE 2.33. DIESEL LOCOMOTIVE EMISSIONS

County	Fuel Used (gal/yr)	Baseline Emissions (kg/day) VOC	Baseline Emissions (kg/day) NO_x
A	7,430,000	920	3,419
B	3,760,000	465	1,730
C	8,030,000	994	3,696
D	5,940,000	735	2,734

Average locomotive emission factors were used for this category. They are given in AP-42 as 99.5 pounds per thousand gallons for hydrocarbons and 370 pounds per thousand gallons for oxides of nitrogen.

2.5.5 Aircraft

The only airport in the region is the Ozoneville International Airport in County C. The aircraft source category includes exhaust emissions from aircraft and ground handling equipment. The activity parameter upon which emissions are based is the annual number of landing-takeoff cycles (LTOs) for three types of aircraft: commercial, civil, and military. This data was acquired for calendar year 1980 from the FAA Aviation Forecast. Emissions were calculated using AP-42 emission factors as shown in Table 2.34.

Estimates of growth rates in air traffic for the Ozoneville International Airport were also provided in the FAA Aviation Forecasts and were used to derive 1987 projection year LTOs. This reference provides information on number of operations, from which LTOs can be calculated by dividing by two.

TABLE 2.34. AIRCRAFT EMISSIONS AT THE OZONEVILLE INTERNATIONAL AIRPORT

Aircraft Type	1980 LTO Cycles	1987 LTO Cycles	Emission Factors (lbs/LTO-engine)		Reactive VOC Emissions (kg/day)		NO_x Emissions (kg/day)	
			VOC	NO_x	Base Year	Baseline Projection	Base Year	Baseline Projection
Air Carrier								
Long-Range Jet (707)	690	807	41.2	7.9	356	414	7	8
Medium-Range (DC 9, 727)	8,759	9,985	4.9	10.2	53	61	111	127
Air Taxi								
Piston Transport	480	707	40.7	0.40	24	36	0	0
Turboprop	4,320	6,696	1.1	1.2	6	9	6	9
Military								
Military Jet	3,574	4,074	9.93	3.29	44	50	59	73
Military Piston	150	225	20.4	0.20	4	6	0	0
Helicopter	38	43	0.52	0.57	0	0	0	0
General Aviation								
Business Jet	23,836	27,172	3.6	1.6	107	122	47	54
Turboprop	35,754	55,419	1.1	1.2	49	76	53	83
Piston	11,918	17,877	0.40	0.047	6	9	1	1
Total					649	783	284	355

2.6 REFERENCES

1. Procedures for the Preparation of Emission Inventories for Volatile Organic Compounds, Volume I, Second Edition, EPA-450/2-77-028; OAQPS, U.S. EPA, Research Triangle Park, NC 27711; September 1980.

2. Compilation of Air Pollutant Emission Factors (Including Supplements 1-10), AP-42; OAQPS, U.S. EPA, Research Triangle Park, NC 27711; February 1980.

3. Final Emission Inventory Requirements for 1982 Ozone State Implementation Plans, EPA-450/4-80-016, OAQPS, U.S. EPA, Research Triangle Park, NC 27711; December 1980.

4. Volatile Organic Compound (VOC) Species Data Manual, Second Edition, EPA-450/4-80-015; OAQPS, U.S. EPA, Research Triangle Park, NC 27711; July 1980.

5. Highway Statistics 1978; Federal Highway Administration, U.S. DOT, Washington, D.C.

6. County Business Patterns 1980; Bureau of the Census, U.S. DOC, Washington, D.C.

7. Residential and Commercial Area Source Emission Inventory Methodology for the Regional Air Pollution Study (RAPS), EPA-450/3-75-078; OAQPS, U.S. EPA, Research Triangle Park, NC 27711; September 1975.

8. Aerometric and Emissions Reporting System; OAQPS, U.S. EPA, Research Triangle Park, NC 27711.

9. Energy Data Reports Sales of Fuel Oil and Kerosine; Bureau of Mines, U.S. Department of the Interior, Washington, D.C.

10. 1979 Census of Agriculture; Bureau of the Census, U.S. DOC, Washington, D.C.

11. Statistical Abstract of the United States; Bureau of the Census, U.S. DOC, Washington, D.C.

12. FAA Aviation Forecast; Federal Aviation Administration, U.S. DOT, Washington, D.C.

3.0 POINT SOURCES

This section documents the development of the point source emission inventory for reactive VOC's and NO_x for the Ozoneville nonattainment area. In this inventory, point sources are defined as any facilities whose emissions of reactive VOC and NO_x equal or exceed 250 kg/day and/or for which individual records are maintained. In many instances, point source data are maintained for points emitting less than 250 kg/day if they are part of facilities whose emissions exceed the point source cutoff. In some instances, facilities emitting less than 250 kg/day are covered as point sources where it is felt that such treatment is necessary to better simulate the effects of controls on these sources in projection inventories.

The emissions from each point source in the inventory represent those emitted on a typical weekday during the summer ozone season. The baseline year is 1980. The baseline projection year is 1987; this projection includes changes expected due to growth and to control limits specified by the 1979 SIP revision. The control strategy projection year is 1987; this projection includes the effect of proposed controls specified in the 1982 SIP revision.

The procedures followed in developing the point source inventory were based on Procedures for the Preparation of Emission Inventories for Volatile Organic Compounds Volume I, Second Edition, EPA-450/2-77-028 and Final Emission Inventory Requirements for 1982 Ozone State Implementation Plans, EPA 450/4-80-016. Emission factors and other emission estimates were obtained from Compilation of Air Pollution Emission Factors (including supplements 1 - 10), AP-42 and from appropriate control technique guidelines (CTG's). Information on products, solvent usage, employment, and growth was obtained from questionnaires used in the 1980 VOC plant survey. Other demographic and employment data were supplied by the Ozoneville Regional Planning Authority.

The point source documentation is broadly organized to correspond to major RACT categories. Data on individual point sources are placed in the appropriate emission category. This includes all data pertinent to source operation, solvent and fuel usage, solvent storage, estimated growth, and other parameters needed to complete the emission determinations. Calculations and assumptions used in estimating base year and projection emissions are presented, along with discussions of the degree of controls to be imposed as a result of the measures incorporated in the 1979 and 1982 SIP's.

3.1 TANK FARMS

The Company G Oil Company operates a tank farm in County D. The facility consists of 20 identical fixed-roof tanks, each 100 feet in diameter and having an average vapor space height of 7 feet. Each tank has a white roof and shell in good condition. During the summer, the tank farm stores only gasoline (RVP 10) and has no daily variation in either the quantity stored or the daily throughput of 20,000 gallons per tank. The conditions during the summer average an ambient temperature of 80°F, an average diurnal variation of 15°F, and an atmospheric pressure of 14.7 psia. The company reported no planned increase in capacity, but expected a throughput increase of 5% per year through 1990.

From AP-42[1], the fixed-roof breathing losses, L_B, can be estimated from

$$L_B = 2.21 \times 10^{-4} M \left[\frac{P}{14.7-P}\right]^{0.68} D^{1.73} H^{0.51} T^{0.50} F_p C K_c \text{ lb/day}$$

where M = molecular weight of vapor in storage tank (66 lb/lb mole),
P = true vapor pressure at bulk liquid conditions (7.4 psia),
D = tank diameter (100 feet),
H = average vapor space height (7 feet),
T = average diurnal temperature change (15°F),
F_p = paint factor (1.0),
C = adjustment factor for small diameter tanks (1.0),
K_c = crude oil factor (1.0).

Substituting into the above equation, L_B = 443.6 lb/day = 201.6 kg/day per tank

The fixed-roof working losses, L_W, can be estimated from

$$L_W = 2.40 \times 10^{-2} M P K_n K_c \text{ lb/day}$$

where M, P, and K_c are defined above and K_n = turnover factor = 1.0. Substituting into the equation, L_W = 11.7 lb/10^3 gal throughput. Since the daily throughput is 20,000 gallons,

$$L_W = (11.7)(20) = 234.0 \text{ lb/day} = 106.4 \text{ kg/day per tank.}$$

The total losses from each tank are

$$L_{total} = 201.6 + 106.4 = 308 \text{ kg/day.}$$

The total baseline emissions, L_T, from the entire tank farm are

$$L_T = (308)(20) = 6160 \text{ kg/day.}$$

Since the losses were calculated with data from the ozone season and since there are no daily variations, no seasonal or weekday adjustments are applied to the emissions.

The projected 5% annual growth gives a growth factor of 1.41 from 1980 to 1987 which is applicable to the working losses only, since throughput rather than capacity is affected by the growth. Therefore the losses from the 20 tanks because of increased throughput in 1987 are

$$L = (201.6 + (106.4)(1.41))\ 20 = 7032.5 \text{ kg/day.}$$

The 1979 SIP revision required a 90% reduction in emissions from fixed-roof petroleum storage tanks, so the baseline projection emissions are

$$L = (7032.5)(0.10) = 703.3 \text{ kg/day.}$$

The 1982 SIP revision has no further requirements for emission reductions. The emissions are summarized in Table 3.1.

TABLE 3.1. SUMMARY OF POINT SOURCE TANK FARM EMISSIONS

			Reactive VOC Emissions (kg/day)		
County	Company	Growth factor	Baseline	Baseline projection	Control strategy
D	Company G Oil Company	1.41	6,160.0	703.3	703.3

PRINCIPAL EMITTING OPERATIONS AT POINT SOURCES OF REACTIVE VOC
FOR OZONEVILLE
(kg/day for a typical summer weekday in the base year)

Name and location Company G Oil Company in County D

Major reactive VOC source category Tank Farms

PRINCIPAL EMITTING OPERATION	VOC
Fixed-Roof Tanks	6,160.0

3.2 RUBBER TIRE MANUFACTURING

Company A Tire Company manufactures rubber tires and is located in County C. In reply to the survey questionnaire, Company A was unable to provide solvent usage data for each operation, but did supply the 1980 operating information which follows.

Company A operates on a 7 day workweek, 52 weeks per year and produces tires at a rate of 12,000 per day. Hexane, which is reactive, is the solvent used in all the company's tire manufacturing operations. It is stored in a 75,000-gallon fixed-roof tank and an average of 45,000 gallons per month are purchased. The company estimates 3% per year growth from 1980 through 1987.

3.2.1 VOC Calculations for Tire Manufacturing Operations

Because Company A was unable to supply solvent usage data for specific operations, the reactive VOC emissions from each operation were determined from the VOC emission factors for each process (EPA-450/2-78-030)[2]. These factors allow emission estimates based on the number of tires produced. One major operation at Company A, sidewall cementing, is not covered in EPA-450/2-78-030[2]. This process is estimated to have emissions at approximately half the level of undertread cementing or (0.5) 0.095 = 0.0475 kilograms VOC per tire. The emissison factors and the resulting baseline emissions for each operation are summarized below.

Operation	Emission Factor (kg VOC/tire)	1980 Baseline Emissions (kg/day)
Undertread cementing	0.095	1140
Bead cementing	0.0082	98.4
Tire building	0.033	396
Tread end cementing	0.015	180
Green tire spraying	0.100	1200
Molding and curing	0.0057	68.4
Finishing	0.002	24
Sidewall cementing	0.0475 (estimated)	570

3.2.2 VOC Calculations for Solvent Storage

Tank type: fixed roof, new condition
Number of tanks: one
Tank diameter: 35 feet
Tank height: 12 feet
Average diurnal temperature change: 15°F
Solvent stored: hexane
Annual average temperature: 60°F
Average temperature for July: 80°F
Tank capacity: 75,000 gallons
Tank paint: specular aluminum
Throughput: 1500 gal/day
Average vapor space weight: 1.2 feet

Calculation of breathing loss, L_B from AP-42[1] :

$$L_B = 2.21\mathrm{x}10^{-4} M\left[\frac{P}{14.7-P}\right]^{0.68} D^{1.73}\ H^{0.51}\Delta T^{0.50} F_p C K_c$$

where M = molecular weight of vapor in tank = 86,
P = true vapor pressure @ 60°F = 1.84 psia,
D = tank diameter,
H = average vapor space height,
T = average ambient temperature change from day to night,
F_p = paint factor = 1.0,
C = adjustment factor for small-diameter tanks = 0.70, and
K_c = crude oil factor = 1.0.

Therefore,

$$L_B = 2.21 \times 10^{-4}(86)\left[\frac{1.84}{14.7-1.84}\right]^{0.68}(35)^{1.73}(12+1.2)^{0.51}(15)^{0.50}(1.0)(0.7)(1.0)$$

$$= 24.1 \text{ lb/day} = 11.0 \text{ kg/day.}$$

Seasonal Adjustment of breathing loss:

A seasonal adjustment factor may be determined by calculating the ratio of the breathing loss at 60°F to the breathing loss at 80°F. In the breathing loss calculation above, P is the only variable dependent on temperature since T does not vary seasonally to any great degree. Thus,

$$\left[\frac{L_{B\ \mathrm{annual}}}{L_{B\ \mathrm{ozone}}}\right] = \left[\frac{P_{\mathrm{annual}}/(14.7 - P_{\mathrm{annual}})}{P_{\mathrm{ozone}}/(14.7 - P_{\mathrm{ozone}})}\right]^{0.68}.$$

P_{annual} = 1.84 psia @ 60°F, and P_{ozone} = 3.17 psia @80°F.

$$\left[\frac{L_{B\ \mathrm{annual}}}{L_{B\ \mathrm{ozone}}}\right] = \left[\frac{(1.84/(14.7 - 1.84)}{3.17/(14.7 - 3.17)}\right]^{0.68} = 0.64, \text{ or } L_{B\ \mathrm{ozone}} = 1.56\ L_{B\ \mathrm{annual}}.$$

Therefore, the breathing loss during the oxidant season becomes

$$L_{B\ \mathrm{ozone}} = (1.56)(11.0 \text{ kg/day}) = 17.2 \text{ kg/day.}$$

Calculation of working loss, L_W, from AP-42[1] :

$$L_W = 2.40 \times 10^{-2}\ MPK_nK_c$$

where M = molecular weight of vapor,
P = true vapor pressure,
K_n = turnover factor = 1.0, and
K_c = crude oil factor = 1.0.

Therefore,

$$L_W = 2.40 \times 10^{-2}(86)(1.84)(1.0)(1.0)$$
$$= 3.8 \text{ lb/day} = 1.7 \text{ kg/day.}$$

Seasonal adjustment of working loss:

As with the breathing loss calculation, the P in the above working loss equation becomes the only variable associated with seasonal changes. Thus,

$$\left[\frac{L_{w\ annual}}{L_{w\ ozone}}\right] = \left[\frac{P_{annual}}{P_{ozone}}\right] = \frac{1.84}{3.17} = 0.58, \text{ and } L_{w\ ozone} = 1.7\ L_{w\ annual}.$$

And, the working loss during the ozone season becomes

$$L_{w\ ozone} = (1.7)(1.7\text{ kg/day}) = 2.9\text{ kg/day}.$$

Finally, the total solvent storage VOC emissions are

$$L_{total} = 17.2 + 2.9 = 20.1\text{ kg/day}.$$

3.2.3 Growth Projection and Emission Reduction

The company's expected 3%/year growth through 1987 yields a growth factor of $(1.03)^7$ or 1.23. The 1979 SIP requires reductions in emissions from the following tire manufacturing operations: undertread cementing, 70%; bead cementing, 70%; tread end cementing, 70%; and green tire spraying; 90%. The baseline projection emissions are [(baseline emis.)(growth factor)(1 - % reduction, if applicable)] and thus, they may be summarized.

Operation	Baseline Projection Emissions (kg/day)
Undertread cementing	(1140)(1.23)(0.30) = 420.7
Bead cementing	(98.4)(1.23)(0.30) = 36.3
Tire building	(396)(1.23) = 487.1
Tread end cementing	(180)(1.23)(0.30) = 66.4
Green tire spraying	(1200)(1.23)(0.10) = 147.6
Molding and curing	(68.4)(1.23) = 84.1
Finishing	(24)(1.23) = 29.5
Sidewall cementing	(570)(1.23) = 701.1
Solvent storage	(20.1)(1.23) = 24.7

The 1982 SIP requires no additional reductions for those operations covered in the 1979 SIP; but it does require a 70% reduction in emissions from sidewall cementing operations. Therefore, the control strategy emissions are equal to the baseline projection emissions minus the 70% reduction in emissions from sidewall cementing or

$$1997.5 - (0.70)701.1 = 1506.7\text{ kg/day}.$$

The emissions are summarized in Table 3.2.

TABLE 3.2. SUMMARY OF POINT SOURCE PNEUMATIC RUBBER TIRE MANUFACTURING EMISSIONS

			Reactive VOC Emissions (kg/day)		
County	Company	Growth factor	Baseline	Baseline projection	Control strategy
C	Company A Tire Company	1.23	3696.9	1997.5	1506.7

PRINCIPAL EMITTING OPERATIONS AT POINT SOURCES OF REACTIVE VOC FOR OZONEVILLE

(kg/day for a typical summer weekday in the base year)

Name and location Company A Tire Company in County C

Major reactive VOC source category Rubber Tire Manufacturing

PRINCIPAL EMITTING OPERATION	VOC
Undertread and sidewall cementing	1710
Bead cementing	98.4
Tire building	396
Tread end cementing	180
Green tire spraying	1200
Tire curing	68.4
Solvent storage	20.1
Other (Finishing)	24
TOTAL	3696.9

3.3 PAPER COATING

Four companies in the four-county nonattainment area do some form of paper coating. The four companies submitted information on solvent use and emissions (in response to a survey) in several formats; therefore, the calculations for reactive VOC are handled individually for each company.

3.3.1 Company K

Company K in County B coats paper used for decorative purposes. The company reported the following solvent usage data for 1980. Coating lines were estimated to account for 95% and solvent losses during mixing for 5% of the 1980 toluene/methanol usage.

Operations	Solvent	Solvent Usage (kg/day)
Coating lines and mixing	toluene	2540
Coating lines and mixing	methanol	2540
Equipment cleanup	isopropanol	265

The operating schedule is 16 hours a day, 5 days a week. The toluene and methanol are stored in 80,000-liter fixed-roof tanks; the isopropanol is stored in a 10,000-liter fixed-roof tank. All tanks are in old tank conditions. All three of the solvents are reactive, thus all emissions are reactive VOC's.

VOC Calculations for Coating Operations - Essentially all of the solvent used in surface coating processes eventually evaporates[3], thus, emissions are 1kg per kg of solvent used.

Emission Point	Solvent	Baseline Emission, 1980 (kg/day)
Coating	toluene	95% (2540) = 2413
	methanol	95% (2540) = 2413
	total	2413 + 2413 = 4826
Mixing	toluene	5% (2540) = 127
	methanol	5% (2540) = 127
	total	127 + 127 = 254
Equipment cleanup	isopropanol	265

Throughput and operation are constant during the year, so no seasonal or weekday adjustment is necessary.

VOC Calculations for Solvent Storage - Breathing losses, L_B, at 60°F (from AP-42)[1] are as follows.

$$\text{Toluene: } L_B = 0.0048 \text{ kg/day}/10^3 \text{ liters} \times \text{capacity} = (0.0048/10^3)(80\times10^3) = 0.384 \text{ kg/day.}$$

$$\text{Methanol: } L_B = 0.0050 \text{ kg/day}/10^3 \text{ liters} \times \text{capacity} = (0.0050/10^3)(80\times10^3) = 0.400 \text{ kg/day.}$$

$$\text{Isopropanol: } L_B = 0.0043 \text{ kg/day}/10^3 \text{ liters} \times \text{capacity} = (0.0043/10^3)(10\times10^3) = 0.043 \text{ kg/day.}$$

Seasonal adjustments in breathing losses, L_B ozone, are calculated as in the coil coating example.

Toluene: L_B ozone = 1.63 L_B annual = 1.63 (0.384)
= 0.626 kg/day.

Methanol: L_B ozone = 1.625 L_B annual = 1.625 (0.400)
= 0.065 kg/day.

Isopropanol: L_B ozone = 1.52 L_B annual = 1.52 (0.043)
= 0.065 kg/day.

The total storage tank breathing losses during the ozone season are

L_B ozone = 0.626 + 0.65 + 0.065 = 1.34 kg/day.

Working losses, L_w, at 60°F (from AP-42)[1] are as follows. For toluene (0.87 kg/liter), the throughput is 2920 liters/day; for methanol (0.79 kg/-liter), the throughput is 3215 liters/day; and for isopropanol (0.79 kg/-liter), the throughput is 335 liters/day.

Toluene: L_w = 0.079 kg/10^3 liters throughput x throughput/day
= (0.079)(2.920) = 0.231 kg/day.

Methanol: L_w = 0.13 kg/10^3 liters throughput x throughput/day
= (0.13)(3.215) = 0.418 kg/day.

Isopropanol: L_w = 0.086 kg/10^3 liters throughput x throughput/day
= (0.086)(0.335) = 0.029 kg/day.

Seasonal adjustments in working losses, L_w ozone, are calculated in the same manner as L_B ozone:

Toluene: L_w ozone = 2.00 L_w annual = 2.00 (0.231)
= 0.462 kg/day.

Methanol: L_w ozone = 1.86 L_w annual = 1.86 (0.418)
= 0.777 kg/day.

Isopropanol: L_w ozone = 1.80 L_w annual = 1.80 (0.029)
= 0.052 kg/day.

The total daily storage tank working losses during the ozone season are

L_w ozone = 0.462 + 0.777 + 0.052 = 1.291 kg/day.

The resulting total storage tank losses, L, during the ozone season are

L_{total} = 1.34 + 1.291 = 2.631 kg/day.

Growth Projection and Emission Reduction - In response to the survey questionnaire, Company K projected a steady 8% per year growth through 1990. Thus $(1.08)^7$ gives a growth factor of 1.71 for 1980 to 1987.

The 1979 SIP requires 81% emission reductions in VOC for paper coating lines. Thus baseline projection emissions for the various operations would be [(baseline emissions)(growth factor)(1 - % reduction, if applicable)].

Operation	Baseline Projection Emissions (kg/day)
Coating lines	(4876)(1.71)(0.19) = 1583
Mixing	(254)(1.71) = 434
Equipment cleanup	(265)(1.71) = 453
Solvent storage	(2.631)(1.71) = 4.5

The 1982 SIP requires no further reductions for any of the operations, so the control strategy emissions are identical to the baseline projection emissions. The emissions are summarized in Table 3.3.

3.3.2 Company L

Company L in County D coats carbon paper. In response to the 1980 survey questionnaire, the company reported exclusive use of the solvent methylethylketone (MEK).

Operation	Solvent	Solvent Usage(kg/day)
Coating lines	MEK	2387
Coating mixing	MEK	126
Equipment cleanup	MEK	125

Company L operates 7 days a week, 24 hours a day. MEK is purchased monthly and stored in a 100,000-liter fixed-roof tank, which is in new tank condition. MEK is reactive, thus all emissions are reactive VOC.

VOC Calculations for Coating Operations - Emission from surface coating operations are 1 kg/kg of solvent used.[3]

Emission Point	Solvent	Baseline Emissions, 1980(kg/day)
Coating lines	MEK	2387
Coating mixing	MEK	126
Equipment cleanup	MEK	125

These emissions require no seasonal adjustment, since throughput and operations in this plant remain constant throughout the year.

VOC Calculations for Solvent Storage - Breathing losses, L_B, at 60°F (from AP-42)[1] are as follows for MEK.

$$L_B = 0.0087 \text{ kg/day}/10^3 \text{ liters} \times \text{capacity}$$
$$= (0.0087/10^3)(100\times10^3) = 0.87 \text{ kg/day.}$$

Seasonal adjustment in breathing losses, L_B ozone, is calculated as before:

$$L_B \text{ ozone} = 1.53\ L_B \text{ annual} = 1.53\ (0.87) = 1.33 \text{ kg/day.}$$

Thus 2.17 kg/day is the total storage tank breathing losses during the ozone season for Company L.

Working losses, L_w, at 60°F (from AP-42)[1] MEK (0.80 kg/liter) and for the total throughput of 3300 liters/day are as follows.

$$L_w = 0.25 \text{ kg}/10^3 \text{ liters throughput} \times \text{throughput/day}$$
$$= (0.25)(3.300) = 0.825 \text{ kg/day.}$$

Seasonal adjustment in working losses, L_w ozone, is calculated as before:

$$L_w \text{ ozone} = 1.75\ L_w \text{ annual} = 1.75\ (0.825) = 1.44 \text{ kg/day.}$$

1.44 kg/day is the total storage tank working loss during the ozone season.

The resulting total storage tank losses, L, are

$$L_{total} = 1.33 + 1.44 = 2.77 \text{ kg/day.}$$

Growth Projection and Emission Reductions - Company L projects a 5% growth rate for 1981 and 1982; 3% for 1983, 1984 and 1985; and 7.5% for 1986 and 1987. The growth factor for 1980 to 1987 is $(1.05)^2\ (1.03)^3\ (1.075)^2$ or 1.39.

The 1979 SIP requires 81% emission reductions in VOC for paper coating lines. Thus the baseline projection emissions for the various operations would be [(baseline emissions)(growth factor)(1-% reduction, if applicable)].

Operation	Baseline Projection Emissions(kg/day)
Coating lines	(2387)(1.39)(0.19) = 630
Coating mixing	(126)(1.39) = 175
Equipment cleanup	(125)(1.39) = 174
Solvent storage	(2.8)(1.39) = 4.0

The 1982 does not require any further reductions, so the control strategy emissions are identical to the baseline projection emissions. The emissions are summarized in Table 3.3.

3.3.3 Company M

Company M in County C coats paper for book covers. The company reported the following production and materials use information for 1980 in response to the survey questionnaire.

Purchases: 12,000 gallons isopropyl alcohol/month
Book cover coating: 22% solids (nitrocellulose), 78% solvent (isopropanol)
Coating uses: 463 gallons/day
Cleanup uses: approximately 450 gallons solvent/month
Operating schedule: 16 hours/day, 7 days/week
Isopropyl alcohol storage: 50,000-liter floating-roof tank, new conditions

Isopropyl alcohol is reactive, so all emissions are reactive VOC.

VOC Calculations for Coating Operations - Isopropanol used in mixing and in coating line operations 12,000 - 450 = 11,550 gal/mo.

Isopropanol used in coating lines totals (463 gal coating/day)(78% solvent) = 361.9 gal solvent/day. Multiplied by 30 days a month the solvent used in coating is 10,857 gal/mo.

Assuming that the storage tank losses are negligible in comparison, solvent losses in mixing must be 12,000 - (450 + 10,857) = 693 gal/mo. The density of isopropanol is 6.6 lb/gal x 0.454 kg/lb = 3.0 kg/gal; employing this factor coupled with surface coating emissions of 1 kg/kg solvent used and assuming 30 days per month, the baseline emissions are summarized below.

Operation	Baseline Emissions, 1980 (kg/day)
Coating lines	(10,857)(3.0)(1/30) = 1085.7
Mixing	(693)(3.0)(1/30) = 69.3
Equipment cleanup	(450)(3.0)(1/30) = 45

VOC Calculations for Solvent Storage - Standing losses, L_S, at 60°F (from AP-42)[1] are as follows for isopropanol.

$$L_B = 0.00052 \text{ kg/day}/10^3 \text{ liters x tank capacity}$$
$$= (0.00052/10^3)(50\times10^3) = 0.026 \text{ kg/day.}$$

Seasonal adjustment in standing losses, L_S ozone, calculated in a similar manner to breathing losses in the coil coating example is as follows for isopropanol.

$$L_S \text{ ozone} = 1.54\ L_S \text{ annual} = 1.54\ (0.026) = 0.04 \text{ kg/day.}$$

The total daily storage tank loss during the ozone season is

L_s ozone = 0.04 kg/day.

There are negligible withdrawal losses for isopropanol in a floating-roof tank, thus the total storage tank losses during the ozone season are

L_{total} = 0.04 kg/day.

Growth Projection and Emission Reduction - Company M projects a 5% growth rate through 1987, thus the growth factor for 1980 through 1987 is $(1.05)^7$ or 1.41.

The 1979 SIP requires 81% emission reductions in VOC for all paper coating lines. The baseline projection emissions would be [(baseline emissions)(growth factor)(1 - % reduction, if applicable)].

Operation	Baseline Projection Emissions(kg/day)
Coating lines	(1085.7)(1.41)(0.19) = 290.9
Mixing	(69.3)(1.41) = 97.7
Equipment cleanup	(45)(1.41) = 63.5
Solvent storage	(0.04)(1.41) = 0.06

The 1982 SIP requires no further reductions for any of the operations, so the control strategy emissions are identical to the baseline projection emissions. The emissions are summarized in Table 3.3.

3.3.4 Company N

Company N in County A manufactures waxed paper. In response to the survey questionnaire, the company reported the following for 1980.

Operation	Solvent	Solvent Usage(kg/day)
Coating lines	toluene	273
	ethyl acetate	230
Mixing	toluene	14
	ethyl acetate	12
Equipment cleanup	toluene	42

The operating schedule for Company N is 8 hours a day, 5 days a week. Toluene and ethyl acetate are each stored in a 15,000-liter fixed-roof tank. The toluene tank is in old condition, and the ethyl acetate tank is in new condition. Both solvents are reactive, therefore the emissions are reactive VOC's.

VOC Calculations for Coating Operations - Emissions from surface coating operations are 1 kg/kg of solvent used[3].

Emission Point	Solvent		Baseline Emissions, 1980(kg/day)
Coating lines	toluene		273
	ethyl acetate		230
		total	273 + 230 = 503
Mixing	toluene		14
	ethyl acetate		12
		total	14 + 12 = 26
Equipment cleanup	isopropanol		42

Throughput and operation are constant during the year, so no seasonal adjustment is necessary.

VOC Calculations for Solvent Storage - Breathing losses, L_B, at 60°F (AP-42)[1] are as follows.

Toluene: L_B = 0.0048 kg/day/10^3 liters x tank capacity
= $(0.0048/10^3)(15x10^3)$ = 0.072 kg/day.

Ethyl acetate: L_B = 0.010 kg/day/10^3 liters x tank capacity
= $(0.010/10^3)(15x19^3)$ = 0.15 kg/day.

Seasonal adjustment in breathing losses, L_B ozone, is calculated as in the coil coating example:

Toluene: L_B ozone = 1.163 L_B annual = 1.63 (0.072) = 0.117 kg/day.

Ethyl acetate: L_B ozone = 1.50 L_B annual = 1.50 (0.15) = 0.225 kg/day.

The total storage tank breathing losses during the ozone season are

L_B ozone = 0.117 + 0.225 = 0.342 kg/day.

Working losses, L_w, at 60°F (AP-42)[1] are as follows.

For toluene (0.87 kg/liter), the throughput is 415 liters/day; for ethyl acetate (0.90 kg/liter), the throughput is 300 liters/day.

Toluene: L_w = 0.079 kg/10^3 liters throughput x tank capacity
= (0.079)(0.415) = 0.033 kg/day.

Ethyl acetate: L_w = 0.028 kg/10^3 liters throughput x tank capacity
= (0.028)(0.300) = 0.0084 kg/day.

Seasonal adjustment in working losses, L_W ozone, is calculated in the same manner as L_B ozone:

Toluene: L_W ozone = 2.00 L_W annual = 2.00 (0.033) = 0.066kg/day.

Ethyl Acetate: L_W ozone = 1.73 L_W annual = 1.73 (0.0084) = 0.015 kg/day.

The resulting total storage tank losses during the ozone season, L, are

L_{total} = 0.342 + 0.081 = 0.42 kg/day.

Growth Projection and Emission Reduction - In response to the survey questionnaire, Company N projected a steady 9% per year growth through 1984, with a leveling off to 0% at that time through 1988. Thus the growth factor is $(1.09)^4$ or 1.41 for 1980 to 1987.

The 1979 SIP requires emission reductions in VOC of 81% for all paper coating lines in the industry; however, Company N is not in compliance with these requirements. Therefore the following are the baseline projection emissions.

Operation	Baseline Projection Emissions(kg/day)
Coating lines	(503)(1.41) = 709.2
Mixing	(26)(1.41) = 36.7
Equipment cleanup	(42)(1.41) = 59.2
Solvent storage	(0.42)(1.41) = 0.6

The 1982 SIP does not require any further reductions for this emissions category; however as part of the control strategy for attainment for 1987, enforcement procedures will be initiated to insure that Company N achieves compliance with the 1979 SIP requirements before 1987. The control strategy emissions are as follows.

Operation	Control Strategy Emissions (kg/day)
Coating lines	(716.3) (0.19) = 136.1
Mixing	114.2
Equipment cleanup	59.2
Solvent storage	0.6

The emissions are summarized in Table 3.3.

TABLE 3.3. SUMMARY OF POINT SOURCE PAPER COATING EMISSIONS

			Reactive VOC Emissions (kg/day)		
County	Company	Growth factor	Baseline	Baseline projection	Control strategy
B	Company K	1.71	5,347.6	2,475.5	2,475.5
D	Company L	1.39	2,641	983	983
C	Company M	1.41	1,200	452.2	452.2
A	Company N	1.41	631	805.7	310.1

PRINCIPAL EMITTING OPERATIONS AT POINT SOURCES OF REACTIVE VOC FOR OZONEVILLE

(kg/day for a typical summer weekday in the base year)

Name and location Company K in County B

Major reactive VOC source category Paper Coating

PRINCIPAL EMITTING OPERATION	VOC
Coating Lines	4826
Coating Mixing	254
Solvent Storage	2.6
Equipment Cleanup	265
TOTAL	5347.6

PRINCIPAL EMITTING OPERATIONS AT POINT SOURCES OF REACTIVE VOC FOR OZONEVILLE

(kg/day for a typical summer weekday in the base year)

Name and location Company L in County D

Major reactive VOC source category Paper Coating

PRINCIPAL EMITTING OPERATION	VOC
Coating Lines	2387
Coating Mixing	126
Solvent Storage	2.8
Equipment Cleanup	125
TOTAL	2641

PRINCIPAL EMITTING OPERATIONS AT POINT SOURCES OF REACTIVE VOC FOR OZONEVILLE

(kg/day for a typical summer weekday in the base year)

Name and location Company M in County C

Major reactive VOC source category Paper Coating

PRINCIPAL EMITTING OPERATION	VOC
Coating Lines	1085.7
Coating Mixing	69.3
Solvent Storage	0.04
Equipment Cleanup	45
TOTAL	1200

PRINCIPAL EMITTING OPERATIONS AT POINT SOURCES OF REACTIVE VOC FOR OZONEVILLE

(kg/day for a typical summer weekday in the base year)

Name and location Company N in County A

Major reactive VOC source category Paper Coating

PRINCIPAL EMITTING OPERATION	VOC
Coating Lines	503
Coating Mixing	26
Solvent Storage	0.42
Equipment Cleanup	42
TOTAL	571.42

3.4 COIL COATING

The Company E Manufacturing Company in County B coats rolls of aluminum alloy which eventually become residential housesiding. The operating schedule is 7 days a week. In response to a survey questionnaire, the company reported the following solvent-use data for 1979:

Operation	Solvent	Solvent Usage (kg/day)
Prime coating	mixed solvents	250
Finish coating	mixed solvents	375
Equipment cleanup	isopropropanol	45

The company included solvent and coating mixing in each operation.

The solvents are purchased and stored in 55 gallon drums. The drums are opened as they are used, and thus have negligable emissions.

The company did not respond to the 1980 survey, so solvent use for 1980 was determined from the company's 7.5% per year forecast of growth from 1979 to 1989. All the solvents are reactive, thus all emissions will be reactive VOC's.

VOC Calculations for Coating Operations - Essentially all of the solvent used in coating operations eventually evaporates, therefore emissions are 1 kg per kg of solvent used.

Emission Point	1979 Baseline Emissions (kg/day)
Prime coating	250
Finish coating	375
Equipment cleanup	45

Projected Emissions, 1980

Emission Point	7.5% Growth	kg/day
Prime coating	(250)(1.075)	268.8
Finish coating	(375)(1.075)	403.1
Equipment cleanup	(45) (1.075)	48.4

Throughput and operation are constant during the year, so there are no seasonal adjustments.

Growth Projection and Emission Reduction - Company E's growth of 7.5%/yr (1980-1987) yields a growth factor of 1.66. The 1979 SIP requires 81% emission reductions for coil coating operations; baseline emissions are equal to [(baseline emis.)(growth factor)(1 - % reduc.)] and summarized below.

Operation	Baseline Projection Emissions (kg/day)
Prime coating	(268.8)(1.66)(0.19) = 84.8
Finish coating	(403.1)(1.66)(0.19) = 127.1
Equipment cleanup	(48.4)(1.66) = 80.3

The 1982 SIP requires no additional controls for coil coating, so the control strategy emissions are identical to the baseline projection emissions. Table 3.4 summarizes the emissions.

TABLE 3.4 SUMMARY OF POINT SOURCE COIL COATING EMISSIONS

			Reactive VOC Emissions (kg/day)		
County	Company	Growth factor	Baseline	Baseline projection	Control strategy
B	Company E Manufacturing	1.66	720.3	292.2	292.2

PRINCIPAL EMITTING OPERATIONS AT POINT SOURCES OF REACTIVE VOC
FOR OZONEVILLE

(kg/day for a typical summer weekday in the base year)

Name and location Company E Manufacturing Company in County B

Major reactive VOC source category Coil Coating

PRINCIPAL EMITTING OPERATION	VOC
Prime coating	268.8
Finish coating	403.1
Equipment cleanup	48.4
TOTAL	720.3

3.5 FABRIC COATING

Company U in County A coats fabric for electrical insulating tapes and for making hoses. A plant visit to Company U revealed the following solvent usage for 1980.

Operation	Solvent	Solvent Usage (gal/yr)
Coating lines	toluene	1,431,500
Mixing	toluene	75,000
Equipment cleanup	toluene	165,000

Company U operates 7 days a week 365 days a year, with throughput constant throughout the year. The company purchases toluene monthly, and stores it in a 150,000-gallon fixed-roof tank in new condition. Since toluene is a reactive solvent, all VOC's will also be reactive.

VOC Calculations for Fabric Coating Operations - Emissions from surface coating operations are 1 kg/kg of solvent used.[3]

Toluene has a density of 7.3 lb/gal(0.454 kg/lb) = 3.314 kg/gal, so the baseline emissions may be summarized as follows.

Emission Point	Baseline Emissions, 1980 (kg/day)
Coating lines	(1,431,500) 3.314/365 = 12,997.2
Mixing	(75,000) 3.314/365 = 681.0
Equipment cleanup	(165,000) 3.314/365 = 1,498.1

VOC Calculations for Solvent Storage - Breathing losses, L_B, at 60°F (from AP-42) for toluene:

$$\begin{aligned} L_B &= 0.035 \text{ lb/day}/10^3 \text{ gal x tank capacity} \\ &= (0.035/10^3)(150 \times 10^3) = 5.25 \text{ lb/day} \\ &= 5.25 \text{ (0.454 kg/lb)} = 2.38 \text{ kg/day.} \end{aligned}$$

Seasonal adjustment of breathing losses, L_B ozone, were calculated the same as the coil coating example.

$$L_B \text{ ozone} = 1.63\ L_B \text{ annual} = 1.63(2.38) = 3.88 \text{ kg/day.}$$

Thus, the total breathing loss during the ozone season is 3.88 kg/day.

Working losses, L_W, at 60°F (from AP-42)[1] for toluene.

The throughput of toluene is 4643 gal/day.

$$\begin{aligned} L_W &= 2.7 \text{ lb}/10^3 \text{gal throughput x tank capacity} \\ &= 2.7(4.643) = 12.5 \text{ lb/day} \\ &= 12.5(0.454 \text{ kg/lb}) = 5.7 \text{ kg/day.} \end{aligned}$$

Seasonal adjustment of working losses, L_W ozone, were calculated the same as the coil coating example.

$$L_W \text{ ozone} = 2.00\ L_W \text{ annual} = 2.00(5.7) = 11.4 \text{ kg/day.}$$

The total working losses during the ozone season are 11.4 kg/day, and the total storage tank losses during the ozone season are:

$$L_{total} = 3.88 + 11.4 = 15.3 \text{ kg/day}.$$

Growth Projection and Emission Reduction - Company U predicts a steady 7% growth per year through the 1980's. Therefore, the growth factor is $(1.07)^7$ or 1.61. The 1979 SIP requires a 81% reduction in solvent emissions at the coating lines in the fabric and vinyl coating industries. Thus the baseline projection emissions (baseline emissions)(growth factor)(1 - % reduction, if applicable) are as follows.

Operation	Baseline Projection Emissions(kg/day)
Coating lines	(12,997.2)(1.61)(0.19) = 3975.8
Mixing	(681.0)(1.61) = 1096.4
Equipment cleanup	(1498.1)(1.61) = 2411.9
Solvent storage	(15.3)(1.61) = 24.6

Since the 1982 SIP requires no further emission reduction for fabric coating or fixed-roof tanks, the control strategy emissions are identical to the baseline projection emissions. The emissions are summarized in Table 3.5.

TABLE 3.5 SUMMARY OF POINT SOURCE FABRIC COATING EMISSIONS

			Reactive VOC Emissions (kg/day)		
County	Company	Growth factor	Baseline	Baseline projection	Control strategy
A	Company U	1.61	15,191.6	7,508.7	7,508.7

PRINCIPAL EMITTING OPERATIONS AT POINT SOURCES OF REACTIVE VOC FOR OZONEVILLE

(kg/day for a typical summer weekday in the base year)

Name and location Company U in County A

Major reactive VOC source category Fabric Coating

PRINCIPAL EMITTING OPERATION	VOC
Coating Lines	12,997.2
Coating Mixing	681.0
Solvent Storage	15.3
Equipment Cleanup	1,498.1
TOTAL	15,191.6

3.6 WOOD FURNITURE

Company T manufactures and coats the surfaces of wooden church pews in County B. Two combinations of coatings are applied: for varnished pews, sealer, stain, and varnish are used, and for painted pews, primer and paint are used. Only the stain is applied by hand; all others are sprayed. The coatings and a solvent (Sol-9) are purchased in 208-liter drums. Sol-9 is used both for thinning the coatings and for equipment cleanup. Company T responded to the 1980 survey with the following data.

Coating	1980 Usage (liter/yr)	Coating Density (kg/liter)	Volatile Reactive Solvents in Purchased Coating (% by wt)	Solvent Added to Purchased Coating (% by vol)
Sealer	27,973	1.52	25	50
Stain	37,853	1.21	0	0
Varnish	29,033	1.55	30	100
Primer	30,320	1.63	30	50
Finish	32,553	1.76	40	100
Sol-9	92,805	0.81	100	not applicable

The work schedule at Company T is 8 hours a day, 5 days a week, 52 weeks a year. The company forecasts a 10% decline in the painted church pew business and a 20% increase in the varnished church pew business by 1987. The use of solvent for cleanup will remain at the 1980 level through 1987.

VOC Calculations for Coating Operations - Essentially all of the solvent used in coating operations eventually evaporates, thus emissions are 1 kg per kg of solvent used. For coating operations at Company T the total emissions from the use of a particular coating is the sum of the emissions from the solvent originally in the purchased coating and the emissions from the solvent added to that coating.

From the solvent in the purchased coating,

$$\text{Emissions/day} = \frac{\text{(1980 usage)(coating density)(\% solvent in coating)}}{\text{(workdays/year)}}.$$

Coating		Coating Solvent Emissions (kg/day)
Sealer	(27,973) (1.52) (0.25)/260 =	40.88
Stain	(37,853) (1.21) (0)/260 =	0
Varnish	(29,033) (1.55) (0.30)/260 =	51.92
Primer	(30,320) (1.63) (0.30)/260 =	57.02
Finish	(32,553) (1.76) (0.40)/260 =	88.14
	Total	237.96

From the solvent added to the coatings,

$$\text{Emissions/day} = \frac{\text{(1980 usage)(\% solvent added) (solvent density)}}{\text{(workdays/year)}}.$$

Coating		Added Solvent Emissions (kg/day)
Sealer	(27,973) (0.50) (0.81)/260 =	43.57
Stain	(37,853) (0) (0.81)/260 =	0
Varnish	(29,033) (1.00) (0.81)/260 =	90.45
Primer	(30,320) (0.50) (0.81)/260 =	47.23
Finish	(32,553) (1.00) (0.81)/260 =	101.42
	Total	282.67

Thus

total emissions/day = coating solvent emissions + added solvent emissions.

Coating		Total Emissions from Coatings (kg/day)
Sealer	40.88 + 43.57 =	84.45
Stain	0 + 0 =	0
Varnish	51.92 + 90.45 =	142.37
Primer	57.02 + 47.23 =	104.25
Finish	88.14 + 101.42 =	189.56
	Total	520.63

The thinning solvent not added to the coatings is used for equipment cleanup. The emissions from this solvent are:

$$\frac{(92{,}805 \text{ liter/yr})(0.81 \text{ kg/liter})}{260 \text{ days/yr}} - 282.67 \text{ kg/day} = 6.45 \text{ kg/day.}$$

Therefore, the 1980 baseline emissions may be summarized as follows.

Operation	Baseline Emissions, 1980 (kg/day)
Varnished pews	226.8
Painted pews	293.8
Cleanup solvent	6.5
Total	527.1

Throughput and operation are constant during the year, so there are no seasonal adjustments.

Growth Projection and Emission Reduction - Company T supplied the following growth factors: 1.2 varnished pews; 0.9 painted pews; and 1.0, cleaning solvent. The 1979 SIP contained no control measures for wood coating; thus, the baseline projection emissions are [(baseline emissions) (growth factor)].

Operation		Baseline Projection Emissions (kg/day)
Varnished pews	(226.8) (1.2) =	272.2
Painted pews	(293.8) (0.9) =	264.4
Cleanup solvent	(6.5) (1.0) =	6.5
Totals	527.1	543.1

The 1982 SIP requires no additional controls for wood furniture surface coating, so the control strategy emissions are identical to the baseline projection emissions. Table 3.6 summarizes the emissions.

TABLE 3.6 SUMMARY OF POINT SOURCE WOOD FURNITURE COATING EMISSIONS

			Reactive VOC Emissions (kg/day)		
County	Company	Growth Factor	Baseline	Baseline Projection	Control Strategy
B	Company T	1.2	226.8	272.2	272.2
		0.9	293.8	264.4	264.4
		1.0	6.5	6.5	6.5
Total			527.1	543.1	543.1

PRINCIPAL EMITTING OPERATIONS AT POINT SOURCES OF REACTIVE VOC FOR OZONEVILLE

(kg/day for a typical summer weekday in the base year)

Name and location Company T in County B

Major reactive VOC source category Wood Furniture Surface Coating

PRINCIPAL EMITTING OPERATION	VOC
Sealer Coating	84.45
Varnish Coating	142.37
Primer Coating	104.25
Finish Coating	189.56
Equipment Cleanup	6.45
TOTAL	527.1

3.7 METAL FURNITURE

The Company I Manufacturing, Inc., produces metal patio furniture in County B. In response to a survey questionnaire, the company indicated that the yearly solvent consumption for 1980 was approximately 20,295 kilograms of perchloroethylene for the cleaning and pretreatment of the furniture, 15,585 kilograms of perchloroethylene for equipment cleanup, and 56,160 kilograms of solvent (composed of several ketones, esters, and alcohol) for the combined coating and mixing operations. All solvents used in the latter process, as well as perchloroethylene, are reactive; thus the VOC emissions are reactive. The company reported an operating schedule of 6 days per week and a projected growth rate of 10% from 1980 to 1990. The 1979 SIP revision required a 75% reduction in reactive VOC emissions from the surface coating lines.

As with most surface coating industries, essentially all of the solvent used in the processes evaporates. The total baseline emissions, then, are the sum of all of the solvents used in the various processes. The baseline emissions for the cleaning and pretreatment become (20,295 kg/yr)/(6 x 52 day/yr) = 65.0 kg/day; and those for the equipment cleanup, and the combined coating and mixing operations become 50.0 and 180.0 kg/day, respectively. There are no seasonal variations to require an ozone season adjustment.

The growth rate given by the company was interpolated to 1987 to give a growth factor of 1.07. The projection factor with the 75% emission reduction gives the baseline projection emissions of

$$(65.0 + 50.0)(1.07) + (180.0)(1.07)(0.25) = 171.3 \text{ kg/day.}$$

The 1982 SIP revision required no further emission reductions. Table 3.7 summarizes the emissions.

TABLE 3.7 SUMMARY OF POINT SOURCE METAL FURNITURE COATING EMISSIONS

			Reactive VOC Emissions (kg/day)		
County	Company	Growth factor	Baseline	Baseline projection	Control strategy
B	Company I Manufacturing Inc.	1.07	295.0	171.3	171.3

PRINCIPAL EMITTING OPERATIONS AT POINT SOURCES OF REACTIVE VOC
FOR OZONEVILLE
(kg/day for a typical summer weekday in the base year)

Name and location Company I Manufacturing Inc. in County B

Major reactive VOC source category Metal Furniture Coating

PRINCIPAL EMITTING OPERATION	VOC
Cleaning and Pretreatment	65.0
Coating Operations(includes coating mixing; coating&solvent mixing)	180.0
Equipment Cleanup	50.0
TOTAL	295.0

3.8 DRY CLEANING

3.8.1 Company B

Company B Cleaners, which employs 35 people, in County A reported cleaning 625 tons of clothing in 1980. The amount of perchloroethylene purchased in 1980 was 68,182 kilograms. Assuming that all of the solvent purchased during 1980 was lost to the atmosphere through evaporation (EPA 450/2-78-050)[4] and since perchloroethylene is considered reactive, the emissions are 68,182 kilograms of reactive VOC per year. Since the reported cleaning activity for this plant stayed essentially constant throughout the year, no seasonal adjustment was applied to the emissions. The plant is open 6 days a week, thus weekday emissions are

$$(68{,}182 \text{ kg/yr})/(6 \times 52 \text{ days/yr}) = 217.9 \text{ kg/day}.$$

Company B could provide no estimates for growth to 1987, so the reactive VOC emissions were projected to grow with the increase in population from 1980 to 1987. For County A, this growth factor is 1.08. The 1979 SIP had requirements for a 70% emission reduction from perchloroethylene dry cleaning operations. Table 3.8 summarizes the reactive VOC emissions data from Company B.

3.8.2 Company O

Company O Cleaners is an industrial-sized dry cleaning establishment in County C. Company O reported cleaning 10,510,000 pounds of clothing and purchasing 1,337,000 kilograms of Stoddard (petroleum) solvent in 1980. The company operates on a 5 day workweek and employs 52 people.

Assuming that all solvent purchased and used during a period of time will be lost to the atmosphere through evaporation (EPA 450/2-78-050)[4] and knowing that Stoddard is reactive, Company O emissions were 1,337,000 kilograms of reactive VOC for 1980. Daily emissions were 1,337,000/5(52) = 5142.2 kilograms per day. Since the Company's volume of cleaning is essentially constant throughout the year, no seasonal adjustment is necessary.

Company O estimated a steady growth of 6% per year through 1987, giving a growth factor of $(1.06)^7$ or 1.50 for 1980 to 1987. The 1979 SIP did not require emission reductions for petroleum solvent dry cleaning, so the baseline projection emissions are

$$5142.2(1.50) = 7713.3 \text{ kg/day}.$$

The 1982 SIP requires a 70% emission reduction for petroleum solvent dry cleaning. Thus, the control strategy emissions will be

$$7713.3(1 - 0.70) = 2314.$$

Table 3.8 summarizes the emissions.

TABLE 3.8 SUMMARY OF POINT SOURCE DRY CLEANING EMISSIONS

County	Company	Growth factor	Reactive VOC Emissions (kg/day)		
			Baseline	Baseline projection	Control strategy
A	Company B Cleaners	1.06	217.9	69.3	69.3
C	Company O Cleaners	1.50	5142.2	7713.3	2314

PRINCIPAL EMITTING OPERATIONS AT POINT SOURCES OF REACTIVE VOC FOR OZONEVILLE

(kg/day for a typical summer weekday in the base year)

Name and location Company B Cleaners in County A

Major reactive VOC source category Perchloroethylene Dry Cleaning

PRINCIPAL EMITTING OPERATION		VOC
Dry cleaning	TOTAL	217.9

PRINCIPAL EMITTING OPERATIONS AT POINT SOURCES OF REACTIVE VOC FOR OZONEVILLE

(kg/day for a typical summer weekday in the base year)

Name and location Company O Cleaners in County C

Major reactive VOC source category Petroleum Solvent Dry Cleaning

PRINCIPAL EMITTING OPERATION	VOC
Dry cleaning	5142.2

3.9 DEGREASING

3.9.1 Company C

Company C Metal Products in County B operates five conveyorized vapor degreasers. In 1980, the company purchased 29,455 kilograms of perchloroethylene and 19,636 kilograms of 1,1,1-trichloroethane, and the company sent to a waste solvent recovery firm outside of the nonattainment area 7364 kilograms of perchloroethylene and 4909 kilograms of 1,1,1-trichloroethane for recycling. Since 1,1,1-trichloroethane is a nonreactive VOC, it is exempt from the inventory; only the perchloroethylene was inventoried. Assuming that all of the perchloroethylene purchased during the year (less the amount recycled) evaporated, the reactive VOC emissions equal 22,091 kilograms per year.

Company C operates 5 days per week, 52 weeks per year. Daily emissions are then

$$(22{,}091 \text{ liters/yr})/(5 \text{ days/wk})(52 \text{ wk/yr}) = 85.0 \text{ kg/day}.$$

The average throughput during the summer quarter was actually 28% because of scheduled maintenance shutdowns during the winter. A factor of 28%/25% or 1.12 was applied to the daily emissions to account for the increase during the ozone season. Thus, the seasonally adjusted or baseline emissions are 95.2 kilograms of reactive VOC per day.

A 5% per year growth from 1980 through 1987 is projected by the company, so a growth factor of 1.41 was applied to the baseline emissions. The 1979 SIP required a 55% reduction in emissions from conveyorized vapor degreasers, so the baseline projection emissions become 60.4 kilograms of reactive VOC per day. These results are in Table 3.9.

3.9.2 Company D

Company D Metal Products in County A operates three open-top vapor degreasers. In 1980, 18,309 kilograms of perchloroethylene were purchased, and none was recovered or recycled. This company has no scheduled maintenance shutdowns or other variations in seasonal production, so no seasonal adjustment was applied to the emissions. A 5 day per week operating schedule results in baseline emissions of (18,309)/(5)(52) = 70.4 kilograms per day. The company estimates the product sales growth as 8% from 1980 through 1985, with static growth thereafter. A growth factor of 1.47 was applied to the baseline emissions. The baseline projection emissions were determined from the 50% reductions required for open-top vapor degreasers in the 1979 SIP. Table 3.9 summarizes the results.

TABLE 3.9 SUMMARY OF POINT SOURCE DEGREASING EMISSIONS

County	Company	Growth factor	Reactive VOC Emissions (kg/day) Baseline	 Baseline projection	 Control strategy
A	Company D Metal Products	1.47	70.4	51.8	51.8
B	Company C Metal Products	1.41	95.2	60.4	60.4

3.10 GRAPHIC ARTS

3.10.1 Company H

The Company H Printing Company operates a packaging rotogravure printing plant in County C. For 1980, the company reported using 118,000 liters of isopropanol for both the ink-mixing and the printing processes. The solvent is stored in a single new fixed-roof 20,000 liter-tank with a throughput of 455 liters per day. Isopropanol is a reactive compound, as will be the VOC emissions from this plant. The plant operates 5 days a week with no seasonal variations in work schedule or production. Since Company H was not able to supply an expected growth rate through 1987, the company's growth was projected to correspond to that of County A's population. The 1979 SIP required a 65% emission reduction from packaging rotogravure printing.

From EPA 450/2-78-033[5], all of the solvent used in the printing process evaporates. The weekday adjusted baseline emissions for the printing process, using a density of 0.79 kilograms per liter for isopropanol, are

$$(118{,}000 \text{ liters/yr}) (0.79 \text{ kg/liter})/(5 \text{ days/wk})(52 \text{ wk/yr}) = 358.5 \text{ kg/day.}$$

No seasonal adjustment of the emissions is necessary.

The storage tank breathing losses, L_B, from the AP-42[1] emission factor are

$$\begin{aligned} L_B &= 0.0038 \text{ kg/day} \times 10^3 \text{ liters} \times \text{tank capacity} \\ &= (0.0038)(20) = 0.076 \text{ kg/day.} \end{aligned}$$

An adjustment to the emissions is necessary to account for the 60°F difference in average ambient temperature for which the emission factor was determined and for the ozone season temperature of 80°F. The AP-42[1] equation is used to give an adjustment factor of 1.52. The baseline emissions for L_B are

$$L_B = (0.076)\ (1.52) = 0.12 \text{ kg/day.}$$

The storage tank working losses, L_w, calculated from the AP-42[1] emission factor are

$$\begin{aligned} L_w &= 0.086 \text{ kg}/10^3 \text{ liters throughput} \times \text{throughput/day} \\ &= (0.086)\ (0.455) = 0.04 \text{ kg/day.} \end{aligned}$$

Using a temperature correction in the equation, the ozone season adjustment factor is 1.8. The baseline emissions for L_w are

$$L_w = (0.04)\ (1.8) = 0.07 \text{ kg/day.}$$

The total baseline emissions from the solvent storage tank are

$$L_{total} = 0.12 + 0.07 = 0.19 \text{ kg/day.}$$

The baseline emissions from the entire plant are 358.7 kilogram per day.

The 1980 through 1987 population growth yields a growth factor for Company H of 1.04. By taking into account the required 65% emission reduction for the printing process, the baseline projection emissions are

$$((358.5)\ (0.35) + 0.19)\ 1.04 = 130.7 \text{ kg/day.}$$

No additional controls are required by the 1982 SIP revision. Table 3.10 summarizes the emissions.

3.10.2 Small Graphic Arts Facilities

There are 9 additional graphic arts point sources, 6 in County A and 1 each in Counties B, C and D. These plants all have daily emissions of reactive VOC's which are less than 250 kilograms. The plant in County D and 4 of those in County A use the rotogravure printing process which is subject to a 65% emission reduction under the 1979 SIP. The remaining plants use the offset method which is subject to a 60% reduction in the 1982 SIP. All purchase and store their solvents in 55-gallon drums. The companies were not able to supply growth rate data so their emissions have been projected to increase with the corresponding county's growth in population. These emissions are summarized in Table 3.10.

TABLE 3.10 SUMMARY OF POINT SOURCE GRAPHIC ARTS EMISSIONS

			Reactive VOC Emissions (kg/day)		
County	Company	Growth factor	Baseline	Baseline projection	Control strategy
C	Company H Printing Company	1.04	358.5	130.7	130.7
A		1.06	29.1	30.8	12.3
A		1.06	78.5	29.1	29.1
A		1.06	87.2	92.4	37.0
A		1.06	101.8	37.8	37.8
A		1.06	43.6	16.2	16.2
A		1.06	148.3	55.0	55.0
B		1.03	177.4	182.7	73.1
C		1.04	58.2	60.5	24.2
D		1.06	133.8	49.6	49.6

PRINCIPAL EMITTING OPERATIONS AT POINT SOURCES OF REACTIVE VOC
FOR OZONEVILLE
(kg/day for a typical summer weekday in the base year)

Name and location Company H Printing Company in County C

Major reactive VOC source category Graphic Arts

PRINCIPAL EMITTING OPERATION	VOC
Rotogravure	358.5
Solvent Storage	0.2
TOTAL	358.7

3.11 WASTE SOLVENT RECOVERY PROCESS

The Company F Recovery, Inc., in County C, specializes in recovering trichloroethylene from vapor degreasing operations. In 1980, the company processed an average of 39,500 kilograms during each 7-day workweek. They used a new 30,000-liter fixed-roof tank to store the waste solvent and packaged the recovered solvent in 55-gallon drums. The amount of solvent processed is estimated by the company to increase at 3% per year through 1987, resulting in a growth factor of 1.23.

The emission factor (EPA 600/2-78-004f)[6] for solvent reclaiming (excluding the storage tank vent) is 2.089 grams per kilogram of solvent processed; trichloroethylene is a reactive VOC, thus the reactive VOC emissions from the company are 11.8 kilograms per day.

Reactive VOC's from solvent tank breathing loss, L_B, and working loss, L_W at 60°F (from AP-42)[1] are:

$$L_B = (0.013\ \text{kg/day-}10^3\ \text{liters})(30\text{x}10^3\ \text{liters}) = 0.39\ \text{kg/day and}$$
$$L_W = (0.34\ \text{kg/}10^3\ \text{liters throughput})(3.9\text{x}10^3\ \text{liters throughput/day}) = 1.33\ \text{kg/day.}$$

Using tank equations (AP-42)[1] with storage temperature as the only variable, the emissions adjusted for 80°F ozone season become

$$L_{B\ \text{ozone}} = (0.39)(1.46) = 0.57\ \text{kg/day,}$$
$$L_{W\ \text{ozone}} = (1.33)(1.67) = 2.22\ \text{kg/day, and}$$
$$L_{\text{total}} = 0.57 + 2.22 = 2.79\ \text{kg/day.}$$

The 1987 baseline projection emissions calculated with the growth factor are

Process: (11.8)(1.23) = 14.5 kg/day,
Storage tank: (2.79)(1.23) = 3.4 kg/day.

The 1982 SIP revision classifies waste solvent recovery as a reactive VOC emission category to which reasonable available control technology (RACT) is applicable, and requires emission reductions of 65%. The storage tank emissions are not affected by this SIP revision; the 1987 control strategy emissions are

Process: (14.5)(0.35) = 5.1 kg/day,
Storage tank: 3.4 kg/day.

The emissions are summarized in Table 3.12.

TABLE 3.11 SUMMARY OF POINT SOURCE WASTE SOLVENT RECOVERY PROCESS EMISSIONS

			Reactive VOC Emissions (kg/day)		
County	Company	Growth factor	Baseline	Baseline projection	Control strategy
C	Company F Recovery, Inc.	1.23	14.6	17.9	8.5

3.12 POWER PLANTS

3.12.1 Company Q

The Company Q Power Company operates a base-load steam electric generating plant with seven coal-fired boilers in County B. Stack tests conducted on the seven boilers in March 1979 indicated NO_x and VOC emissions of 1868.2 and 8.2 kilograms per hour, respectively, and that 70% (5.7 kg/h) of the VOC's emitted from these boilers are reactive. At this time Company Q Power reported coal consumption of 2280 tons per day. The plant operates at maximum generating capacity continually, so no seasonal or weekday adjustments are necessary. The NO_x and VOC emissions are 44,836.8 and 136.8 kilograms per day.

Company officials indicated that an additional coal-fired 120 megawatt output (1260 million BTU/hr) unit is scheduled to come on line in 1985. The estimated coal consumption will be 1100 tons per day. Since this plant is subject to the new source performance standard (NSPS) for electric utility steam generating units built after September 18, 1978 of 0.5 pounds of NO_x per million BTU's of heat input, the 1987 baseline projection emissions of NO_x for this unit are

$$(1260)(0.5)(0.455\ \text{kg/lb})(24\ \text{h/day}) = 6879.6\ \text{kg/day}.$$

Using the March 1979 stack test data, a factor relating reactive VOC emissions to coal consumption may be derived. Specifically,

$$(5.7\ \text{kg VOC/h})(24\ \text{h/day})/(2280\ \text{tons/day}) = 0.06\ \text{kg VOC per ton coal}.$$

Thus, the 1987 baseline projection emissions of reactive VOC for this new unit may be estimated

$$(1100\ \text{tons/day})(0.06\ \text{kg/ton}) = 66.0\ \text{kg/day}.$$

There are no VOC or NO_x emission reduction requirements in either the 1979 or 1982 SIP revisions. Therefore the NO_x baseline projection and control strategy emissions are

$$44{,}836.8 + 6879.6 = 51{,}716.4\ \text{kg/day},$$

and the reactive VOC baseline projection and control strategy emissions are

$$136.8 + 66.0 = 202.8\ \text{kg/day}.$$

The emissions are summarized in Tables 3.12 and 3.13.

3.12 Company R

The Company R Power and Light in County D has four coal-fired boilers which act as peaking units. Stack tests performed in August 1980 provided an emission estimate for NO_x of 280.2 kilograms per hour. Coal consumption at the time of the stack test was 16 tons per hour. Based on the factor derived from stack testing at Company Q, emissions of reactive VOC at Company R are

$$(16\ \text{tons coal/h})(0.06\ \text{kg VOC/ton}) = 0.96\ \text{kg/h}.$$

The company reported that, between 6 a.m. and 12 p.m. (midnight) on a typical summer weekday, the units operate at 80% generating capacity. No power generation occurs from 12 p.m. to 6 a.m. The seasonal power generation is summer 30%, fall 20%, winter 30%, and spring 20%. Based on these values, and assuming that the results from the stack tests represent weekday rates, the NO_x baseline emissions are

(280.2 kg/h)(18 h/day)(0.30/0.20) = 6052.3 kg/day, and

the reactive VOC baseline emissions are

(0.96)(18)(0.30/0.20) = 20.7 kg/day.

The company estimates a 5% per year increase in power demand through 1987, but there are no plans to increase the maximum generation capacity beyond that now available at 100% load; additional power requirements will be met by new plants scheduled to come on-line elsewhere on the company's electrical grid. Therefore, a maximum 20% increase is expected by 1987, so the growth factor is 1.2. The 1979 and 1982 SIP revisions do not identify power plants as a category requiring emission reductions. The NO_x baseline projection and control strategy emissions are

(6052.3)(1.2) = 7262.8 kg/day, and

the reactive VOC baseline projection and control strategy emissions are

(20.7)(1.2) = 24.8 kg/day.

The emissions are summarized in Tables 3.12 and 3.13.

TABLE 3.12 SUMMARY OF POWER PLANT NO_x EMISSIONS

			NO_x Emissions (kg/day)		
County	Company	Growth factor	Baseline	Baseline projection	Control strategy
B	Company Q Power Company	1.0	44,836.8	51,716.4	51,716.4
D	Company R Power & Light	1.2	6,052.3	7,262.8	7,262.8

TABLE 3.13 SUMMARY OF POWER PLANT VOC EMISSIONS

			Reactive VOC Emissions (kg/day)		
County	Company	Growth factor	Baseline	Baseline projection	Control strategy
B	Company Q Power Company	1.0	136.8	202.8	202.8
D	Company R Power & Light	1.2	20.7	24.8	24.8

3.14 REFERENCES

1. Compilation of Air Pollution Emission Factors, Third Edition and Supplements, AP-42, U.S. Environmental Protection Agency, Research Triangle Park, NC, August 1977.

2. Control of Volatile Organic Emissions from Manufacture of Pneumatic Rubber Tires, EPA-450/2-78-030, U.S. Environmental Protection Agency, Research Triangle Park, NC, December 1978.

3. Control of Volatile Organic Emissions from Existing Stationary Sources - Volume II: Surface Coating of Cans, Coils, Paper, Fabrics, Automobiles, and Light-Duty Trucks, EPA-450/2-77-008, U.S. Environmental Protection Agency, Research Triangle Park, NC, May 1977.

4. Control of Volatile Organic Emissions from Perchloroethylene Dry Cleaning Systems, EPA-450/2-78-050, U.S. Environmental Protection Agency, Research Triangle Park, NC, December 1978.

5. Control of Volatile Organic Emissions from Existing Stationary Sources - Volume VIII: Graphic Arts - Rotogravure and Flexography, EPA-450/2-78-033, U.S. Environmental Protection Agency, Research Triangle Park, NC, December 1978.

6. Source Asessment: Reclaiming of Waste Solvents, State of the Art, EPA-600/278-004f, U.S. Environmental Protection Agency, Cincinnati, OH, April 1978.

4.0 HIGHWAY VEHICLES

This section documents the highway vehicle emission inventory for reactive volatile organic compounds (VOC's) and oxides of nitrogen (NOx) produced by gasoline- and diesel-powered motor vehicles. The emission estimates in the inventory are for a typical weekday during the summer oxidant season. In addition to the 1980 base year inventory, two emissions estimates were projected for 1987. The baseline 1987 scenario accounts for growth in the urban area, the Federal Motor Vehicle Control Program (FMVCP), Inspection and Maintenance (I/M), and all transportation control measures committed in the 1979 SIP. The 1987 control strategy scenario accounts for all baseline controls, and all additional Reasonably Available Control Measures (RACM's) committed in the 1982 SIP.

Guidance for the development of this portion of the inventory was provided by Final Emission Inventory Requirements for 1982 Ozone State Implementation Plans, EPA-450/4-80-016, and Guidelines for Review of Highway Emission Inventories for 1982 SIP's, EPA-440/12-80-002. Demographic and employment data used in the travel modeling process were documented in Section 2 of this report and are consistent with projections developed for Ozoneville in accordance with EPA's cost-effectiveness guidelines for wastewater treatment facilities. The transportation models were run by ORPA, with technical assistance from the Ozoneville Department of Transportation (ODOT). Supplementary traffic data were supplied by various other state and local agencies.

The highway vehicle inventory is documented as follows. First, the procedures and models used for estimating regional travel are described. Second, the data input into the emissions models are presented. Third, the 1987 baseline and control strategy scenarios are described in detail, followed by the emissions and travel estimates for all scenarios (1980 Base Case, 1987 Baseline Projection, and 1987 Control Strategy). Finally, the reliability of the inventories is documented using the quality assurance program presented in the EPA document Guidelines for Review of Highway Emission Inventories for 1982 SIP's, EPA-440/12-80-002.

4.1 TRAVEL ESTIMATION PROCESS

4.1.1 Overview of the Travel Estimation Process

ORPA is the responsible agency for preparing the highway vehicle emissions estimates. Travel estimates from two sources--ORPA's travel models and 1977 traffic counts made by the Ozoneville Department of Transportation (ODOT)--were used in developing the travel and emissions inventories. A standard four-step transportation modelling process is used to simulate traffic in all counties of the Ozoneville study area. These models were calibrated using data from a 1960 home interview survey and were validated using 1977 traffic count data. These models produced 1977 and 2000 trip tables which were interpolated to yield the 1980 and 1987 trip tables used in the assignment model to estimate vehicular travel.

4.1.2 Trip Generation Model

Trip productions and attractions for 1977 and 2000 are predicted using a cross classification model based on the 1960 home interview survey, with minor updates to account for the increased size of the study area since 1960. The generation model is stratified by six area types and three trip purposes and estimates trip rates using the number of residents, households, and employees as input variables. The model predicts the number of person trips for home-based work, home-based non-work and non-home-based trip purposes and predicts vehicle trips for trucks and taxis.

4.1.3 Trip Distribution Model

A production constrained gravity model is used for trip distribution. This model is stratified by trip purpose and distributes truck and taxi trips using impedances set equal to the network travel times. For the other trip purposes, the impedance is a more complicated function of both auto and transit travel times. To develop the impedance for these trip purposes, the highway travel time is multiplied by a factor which accounts for the impact that a low transit travel time (as compared to highway travel time) has on trip distribution.

4.1.4 Mode Split Model

A probit modal split model calibrated from the 1960 survey data is used for modal split analysis. This model is stratified by three trip purposes, two transit service types, and two auto ownership categories. Time and cost for transit and highway trips are used as input variables. The mode choice model allocates person trips for each of the trip purposes (HBW, HBNW and NHB) into two modes - auto and transit. The auto trips are then subdivided into drivers and passengers using an auto occupancy model. This model is also based on 1960 home interview data and is stratified by trip purposes. Non-home-based trips are assumed to have a constant occupancy of 1.34, while occupancies for the other purposes are assumed to be functions of highway travel time. Finally, the transit trips are subdivided into the two submodes (i.e., bus and commuter rail) based on the assumption that all travellers will use the shortest-time transit path to reach their destination.

The trip tables originally produced by the mode split model are for travel in 1977 and 2000. In order to convert these trip tables to the years appropriate for the SIP, a non-linear interpolation was performed which produced factors to estimate the changes in productions and attractions for 1980 and 1987. A fratar model was used to convert the change in trips ends into updated trip tables for 1980 and 1987.

4.1.5 Traffic Assignment Model

An iterative, capacity-restraint technique is used to load vehicle trips onto the network. The network used for 1980 was based on a 1976 ORPA roadway network updated by including highway projects which measurably impact capacity, demand, or speed and were due for completion before or during 1980. Highway and transit networks reflecting the baseline and the control strategy conditions in 1987 were also utilized in this analysis.

Trips were loaded onto these networks using an all or nothing assignment technique. Travel times were readjusted on each link using volume to capacity relationships and then the trips were re-loaded onto the revised network. This process was repeated three times. The results from each iteration were then averaged to produce a single set of link volumes.

4.1.6 Off-Network VMT

Off network travel in the ORPA area represents about 15% of the total travel in the area. This travel was accounted for by multiplying the intrazonal trips (estimated by the distribution model but not assigned) and a representative intrazonal travel distance. This representative distance is assumed to be equal to the average trip length of one-half the over-the-road radius of each zone. To simplify this process, average zonal radii, stratified by area type, were employed. Off network speed is assumed to be 20 mph.

4.1.7 Speed Estimates

The speeds used as an input to MOBILE 1 were estimated for each link using the procedure documented in the ORPA study, Freeway and Arterial Operating Speeds (1975). This report related speed for all vehicle types to volume, capacity, speed limit and signal density on the link. ORPA modified this procedure by adjusting the minimum speed up from 2.5 miles per hour and by dampening the decrease in travel speed after volume exceeds capacity. The input speed limits and minimum speeds are based on default values except where those values were obviously inappropriate for Ozoneville. The number of signals per mile is based on data from ORPA's road inventory file.

4.1.8 Quality Assurance of the Travel Estimation Process

The travel models were validated by comparing ground counts taken in 1976 and 1977 to simulated traffic volumes for 1977. The results showed that the estimated error is within 10% for 10 of 12 screenlines and that the total simulated traffic crossing all screenlines overestimates the observed traffic by 2% (see Table 4.1). Another validation was made by comparing 1975 crossings of the Flood River Cordon line to simulated crossings of this cordon. The results show that the maximum error for the various segments of the cordon was 13% while the error for the entire cordon was 5%. Finally, 1977 simulated and observed transit patronage (by submode) was compared (see Table 4.2). Although the simulation models under-estimated commuter rail travel by 15%, total transit patronage was estimated to within about 1%.

4.2 EMISSION ESTIMATION PROCESS

4.2.1 Overview of Emissions Estimation Process

ORPA used information from its travel modelling process, various count programs and several national studies to estimate highway emissions. Emissions were computed on an hourly basis for each link in the highway network, and for each zone for off-network travel. These emissions are then allocated to a 5km grid system based on the location of each link or zone. Ozoneville's network calculation model does not distinquish travel-based and trip-based emissions. The emission factors used were estimated with EPA's MOBILE 1 model.

TABLE 4.1 VALIDATION RESULTS FOR 1977 SCREENLINE COUNTS

Screenline	Ground Count	Model Assignment	Ratio of Assignment/Ground Count
A	348,088	354,451	1.02
B	191,127	200,525	1.05
C	395,446	439,049	1.11
D	228,271	260,778	1.14
E	223,546	208,984	0.93
F	137,507	131,057	0.96
G	55,346	43,655	0.78
H	162,410	156,854	0.97
I	57,455	56,181	0.98
J	84,319	82,810	0.98
K	152,648	164,541	1.08
L	227,482	224,662	0.99
Total	2,155,244	2,298,394	1.02

TABLE 4.2 COMPARISON OF 1977 PASSENGER COUNTS WITH ASSIGNED VOLUMES

Submode	1977 Passenger Counts	1977 Assigned Volumes	Percent Differences
Commuter Rail	3,600	3,060	-15%
Bus	548,400	543,420	-0.9%
Total	552,000	546,480	-1%

TABLE 4.3 VEHICLE MIX DISTRIBUTIONS

Route Type	Vehicle Type					
	LDV	LDT 1	LTD 2	HDG	HDD	MC
Freeway/Expressway	0.82	0.04	0.03	0.04	0.07	0
Major Arterial	0.83	0.05	0.03	0.03	0.06	0
Minor Arterial	0.84	0.05	0.03	0.03	0.05	0
Collector	0.86	0.05	0.03	0.03	0.03	0
Local	0.84	0.06	0.03	0.02	0.02	0.03
Average	0.835	0.050	0.03	0.03	0.05	0.005

Source: ODOT, Vehicle Classification Counts

4.2.2 Inputs to the Emissions Model

The hourly distributions of light duty vehicle and truck travel were obtained from a 1972 FHWA report (An Analysis of Urban Area Travel by Time of Day). This information was checked against data collected in 1978 from 20 count stations in the Ozoneville urban area. These counts were used to adjust the FHWA distributions where available local information was found to be significantly different.

The second input, the distribution of VMT by vehicle class, was obtained from several hundred classification counts performed in 1977 and 1978. These counts resulted in an estimate of light and heavy-duty vehicles stratified by functional class. The heavy-duty vehicles were further stratified into diesel and gas trucks using VMT data obtained from the 1977 Census of Transportation for each type of truck registered in the Ozoneville study area. The light duty vehicles were divided into auto and light duty trucks, based on statewide registrations. Light duty trucks were further split into LDT 1 and LDT 2 based on national sales statistics stratified by model year (See Table 4.3) Data on the distribution of VMT by age of vehicle is based on the MOBILE I defaults.

The third input to the emissions model is the summertime adjustment factor. This factor converts the annual average weekday traffic estimated by ORPA's models to the average summer weekday traffic. These factors are the reciprocal of the factors used by the transportation department in Ozoneville to convert traffic counts made during a summer weekday into an annual daily traffic estimate. The data source for these factors is traffic counts from permanent traffic counting stations.

The temperatures used in MOBILE 1 were obtained from the National Weather Service and varied with the time of day (See Table 4.4).

The percentage of cold and hot starts was estimated using the abbreviated procedure developed by the State of Alabama Highway Department for FHWA 1/ (see Table 4.5). The input data for the procedure was developed from the distribution of trips stratified by area type and purpose and the average auto trip length stratified by trip purpose. These inputs were generated using the 1977 ORPA travel simulation model. Another input, the fraction of travel by trip purpose and time of day was obtained from the 1960 home interview survey.

The final input to the emissions model is the I/M program. Only emission factors for the 1987 scenarios are affected by I/M as it is currently scheduled for implementation in 1982. All light duty vehicles must submit to the yearly inspection at a licensed, privately-owned inspection station. The state has provided subsidies for mechanic training beginning in 1981. A stringency factor of 25% is used when calculating emission factors.

1/ Ellis, G. W., et. al., The Determination of Vehicular Cold and Hot Operating Fractions for Highway Emissions Calculation. DOT-FH-11-9207

TABLE 4.4 AVERAGE TEMPERATURES AND HUMIDITY, JUNE-AUGUST

Period	Hours	Degrees Fahrenheit
AM Off-Peak	3 - 6	72°
Peak	6 - 9	74°
Mid-Day	9 - 15	85°
PM Peak	15 - 18	87°
Evening	18 - 21	79°
Off-Peak	21 - 3	74°

Humidity: 103 grains per pound
Average dewpoint: 68°F

Source: National Weather Service Statistics: Ozoneville 1980.

TABLE 4.5 COLD/HOT START OPERATING FRACTIONS BY PERIOD AND AREA

PERIOD (HRS)	NONCATALYTIC				CATALYTIC							
	% COLD				% HOT				% COLD			
	CBD	URBAN	SUBURBAN	RURAL	CBD	URBAN	SUBURBAN	RURAL	CBD	URBAN	SUBURBAN	RURAL
3-6	34	36	36	36	6	4	5	5	36	38	38	38
6-9	35	36	37	37	7	5	6	6	35	37	37	37
9-15	9	13	14	14	33	29	29	28	21	25	25	26
15-18	20	21	19	19	20	18	20	21	28	29	28	28
18-21	8	9	9	9	29	25	25	25	25	28	29	29
21-3	20	19	18	18	16	16	17	17	35	36	36	36

Regional Daily Average

NONCATALYTIC	CATALYTIC	
% Cold	% Hot	% Cold
19	21	29

Source: ORPA, Survey Data

4.3 BASELINE AND CONTROL STRATEGY TRAVEL AND EMISSIONS PROJECTIONS

4.3.1 Description of Base Year, Baseline Projection, and Control Strategy Scenarios

4.3.1.1 Base Year Scenario

A Baseline scenario was constructed for the period 1980 through 1987 for the highway emission inventory. For the 1980 base year, estimated 1980 study area population and employment were used to forecast total travel demand. All highway and transit improvements scheduled to be operational in the study area by the end of 1980 were included in the 1980 transit and highway networks. These improvements included the following:

- completion of I-00 in County C,
- HOV lanes on 7 miles of SR-100,
- a 5 percent increase in transit service, and
- the opening of six park and ride lots.

The previously described travel and emission modelling procedures were used in conjuction with these imputs to estimate 1980 travel and VOC and NOx emissions for the study area.

4.3.1.2 Baseline Projection Scenarios

The Baseline scenario for 1987 accounts for the following:

- projected population and employment growth between 1980 and 1987,
- changes in the price of gasoline over time,
- the FMVCP,
- the implementation of the area's I/M program in 1982, and
- all recommended RACM's in the 1979 SIP.

According to the 1979 SIP, the major RACM's scheduled to be implemented by 1987 include:

- completion of the commuter rail line from County B,
- a 10% increase in transit service,
- HOV lanes in both directions on I-00, in County C, and
- introduction of an areawide ridesharing program.

The 1980 transit and highway networks and other inputs to the travel and emission forecasting procedures were updated to reflect the above conditions for 1987.

4.3.1.3 Control Strategy Scenario

The 1987 Control Strategy scenario includes all of the 1987 Baseline RACM's and other inputs plus additional transportation RACM's necessary to meet the NAAQS for ozone. ORPA, DER and the effected local governments jointly determined the targeted emission reductions from the baseline condition for point, area and highway sources. It was decided that highway emissions should be reduced an additional 5% below the 1987 Baseline Condition.

As outlined in the EPA-DOT Transportation-Air Quality Planning Guidelines (June 1978), ORPA has emphasized the development and implementation of packages of RACM's to meet the ozone NAAQS by the end of 1987. Specifically, four packages of RACM's are recommended for implementation between 1980 and 1987 (see Table 4.6). These packages, which can be funded and implemented by the end of 1987, are designed to reduce travel and emissions associated with the following travel markets:

- peak and off-peak travel within the central business district (CBD),
- peak period radial travel to and from the CBD,
- peak and off-peak travel to suburban activity centers (e.g., industrial parks, shopping centers, universities, hospitals), and
- non-work travel occurring throughout the study area.

The location of selected RACM's is shown in Figure 4.1. Each package of RACM's is described below.

Package A is designed to improve CBD traffic flow (i.e., speeds), and decrease the number of automobiles operating in the CBD in order to reduce emissions. These objectives will be accomplished through increased parking fees and enforcement, reduced parking availability for commuters, increased CBD transit service, and selected traffic flow improvements.

Package B is intended to reduce emissions related to CBD/Central City (i.e., Ozoneville) oriented work trips. This package concentrates on encouraging peak period travelers to use public transit, carpools and vanpools rather than driving alone to work. The improvements in this package include increases in transit service, leasing/constructing additional park and ride facilities, extending the SR-100 HOV lane an additional 5 miles and implementing a new reserved bus lane on SR-239, ramp metering with HOV by-pass lanes, and an informational campaign stressing the advantages of the new services.

TABLE 4.6 PACKAGES OF REASONABLY AVAILABLE CONTROL MEASURES TO BE IMPLEMENTED

Package A: CENTER CITY TRANSPORTATION IMPROVEMENTS

- $2.00 Increase in parking tax
- Elimination of all long-term on-street parking in CBD
- Institute aggressive parking enforcement program
- Conversion of 12 two-way streets to one-way
- Computerize and synchronize 48 traffic signals in CBD
- Promote use of employer transportation subsidy program (where applicable)
- Operate CBD circulator bus service

Package B: COMMUTER RELATED REDUCTIONS

- 15% Expansion of peak hour transit service
- Lease or construct 2,500 additional park and ride parking spaces
- Install ramp metering and HOV by-pass lanes on three freeways
- Informational campaign to encourage the use of the existing ride sharing program
- HOV lanes on an additional 5 miles of SR-100, and 6 miles of SR-239

Package C: SUBURBAN ACTIVITY CENTER REDUCTIONS

- Assist large employers in developing flextime programs
- Assist large employers in developing their own carpool/vanpool programs
- Synchronize traffic signals on 14 arterials
- Reconstruct 12 intersections to improve geometrics and reduce congestion
- Implement 10 new bus routes serving suburban activity centers

(continued)

TABLE 4.6 (Continued)

Package D: NONWORK TRIP COLD START REDUCTION STRATEGIES

- Establish demand responsive transit service in 6 suburban localities and institute an informational campaign about new services
- Improve bicycle access and storage facilities at three shopping/business developments
- Institute public information campaign to encourage trip-chaining

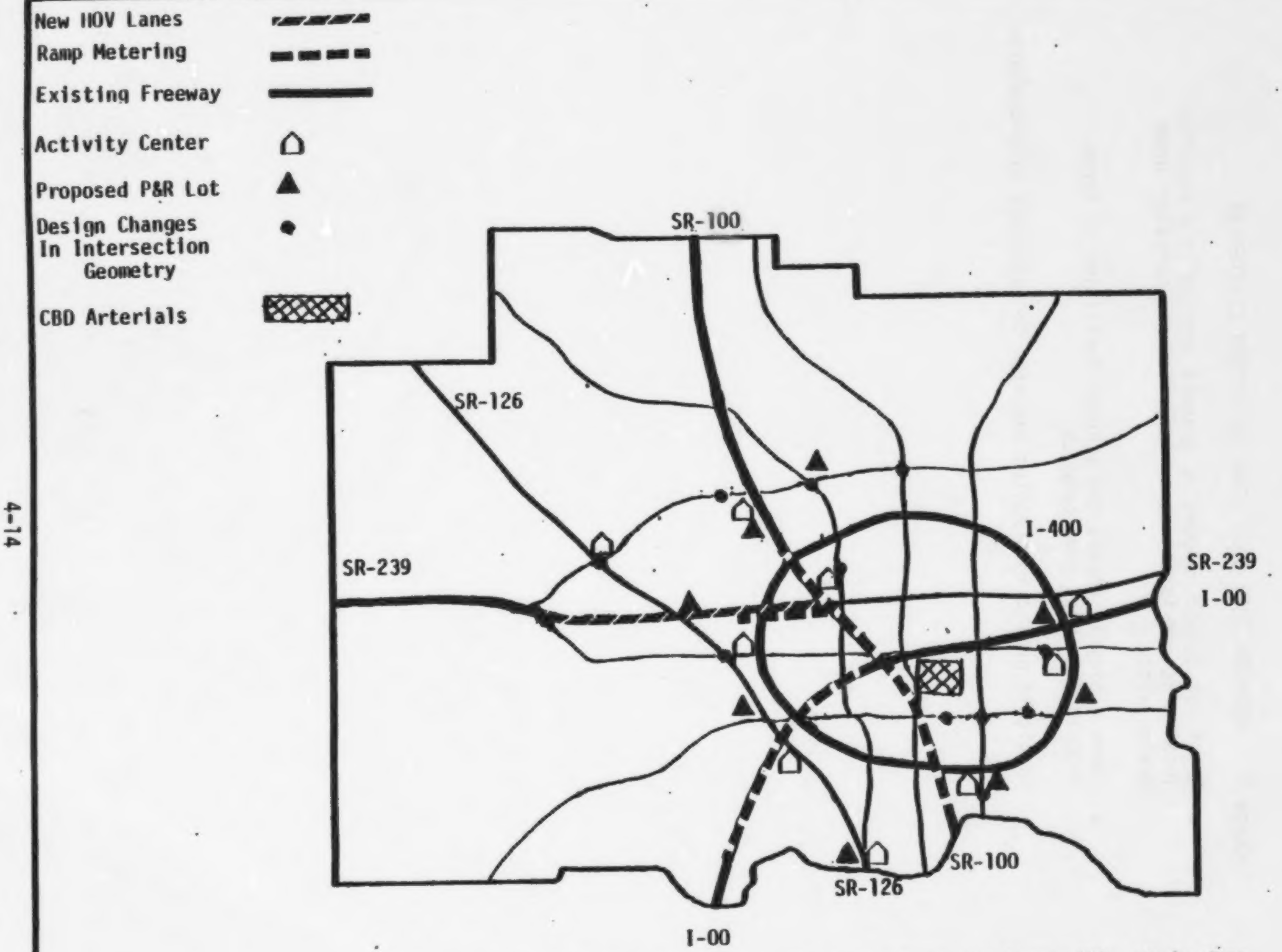
New HOV Lanes
Ramp Metering
Existing Freeway
Activity Center
Proposed P&R Lot
Design Changes In Intersection Geometry
CBD Arterials
SR-100
SR-126
SR-239
I-400
SR-239
I-00
SR-100
SR-126
I-00

Figure 4.1 Major projects included in control strategy for Ozoneville study area.

Package C is designed to reduce emissions related to traffic in the vicinity of suburban activity centers (e.g., industrial parks, shopping centers, and suburban business districts). This package includes providing technical assistance to major employers for establishing carpool/vanpool and flextime programs implementing a series of traffic signalization and intersection geometric improvements, and improving transit service to such centers.

Package D is intended to reduce emissions, particularly cold start emissions, associated with non-work-related vehicle trips. A demand responsive transit system is being established in six local communities, along with regionwide improvements in bicycle facilities. These RACM's are to encourage the use of alternative modes to the private auto for local trips not easily served by fixed route transit. These new services and facilities will be supplemented by a major regionwide information campaign to inform the public of air quality problems and potential actions (e.g., trip chaining) that they can take to reduce emissions.

4.3.2 Travel and Emissions Projections

Because of the expected growth of population in the region, the estimated number of vehicle trips (see Table 4.7) and vehicle miles of travel (see table 4.8) are projected to increase between 1980 and 1987 for both the Baseline and the Control Strategy scenarios. However, the additional RACM's in the Control Strategy scenario are estimated to achieve a 3 percent reduction in total vehicle trips and a 5.5 percent reduction in VMT from the Baseline scenario in 1987. The RACM's in the Control Strategy are estimated to maintain or, for selected classes of highways, improve the average daily operating speeds in the region (see Table 4.9). These speed improvements contribute to the reduction in VOC emissions.

Despite the increases in VMT and total trips from 1980, total VOC and NOx emissions from highway sources in the Baseline scenario decrease significantly by 1987 (Table 4.10) due to the FMVCP and I/M. These programs account for 97 percent of the emission reductions of VOC from highway sources in the Baseline scenario, while the RACM's in the 1979 SIP are responsible for the remaining 3 percent. The reductions for the control strategy are included below.

The effect of the FMVCP can readily be seen in Table 4.11. VOC emissions per VMT in 1987 are approximately 45 percent of those in 1980 at comparable speeds. 1987 Emissions factors for NOx are approximately 60 percent of those in 1980. The proportional effects of the FMVCP, I/M and the combined RACM's can be seen graphically in Figure 4.2.

As indicated in Table 4.10, an additional 5.9 percent reduction in VOC emissions and a 5.4 percent reduction in NOx emissions is estimated to be achieved in 1987 by the implementation of the RACM's in the Control Strategy.

TABLE 4.7 TOTAL FORECASTED DAILY VEHICLE TRIPS

Trip Type	Base Year	Baseline Projection	Control Strategy
Auto Vehicle Trips	3,911,773	4,475,002	4,332,737
Truck Vehicle Trips	440,154	489,130	489,130
Total	4,351,927	4,964,132	4,821,867

TABLE 4.8 DAILY VMT BY COUNTY

County	Base Year	Baseline Projection	Control Strategy
A	7,338,457	8,567,304	8,092,731
B	3,988,066	4,284,218	4,046,689
C	8,724,042	9,709,685	9,170,987
D	4,985,435	5,997,225	5,664,956
Total	24,926,000	28,558,432	26,975,363

TABLE 4.9 AVERAGE DAILY VEHICLE OPERATING SPEED BY HIGHWAY CLASSIFICATION

	Vehicle Operating Speeds (mph)		
Highway Classification	Base Year	Baseline Projection	Control Strategy
Interstate/Freeway/Expressway	45	47	47
Major Arterial	32	33	33
Minor Arterial	22	23	24
Collector	22	22	22
Local	20	20	20
Average Daily Operating Speed	28.9	29.8	30.0

TABLE 4.10 HIGHWAY SOURCE EMISSIONS BY COUNTY

	Reactive VOC (kg/day)			NOx (kg/day)		
County	Base Year	Baseline Projection	Control Strategy	Base Year	Baseline Projection	Control Strategy
A	30,686	15,104	14,309	24,298	18,071	17,061
B	16,930	7,553	9,123	10,603	7,363	6,930
C	37,035	17,118	15,818	38,435	30,120	28,400
D	21,164	10,573	10,136	15,021	11,379	10,941
Total	105,815	50,348	47,381	88,357	66,933	63,332

TABLE 4.11

EMISSION FACTORS BY HIGHWAY CLASSIFICATION*

	Reactive VOC (gr/mi)			NOx (gr/mi)		
Highway Classification	Base Year	Baseline Projection	Control Strategy	Base Year	Baseline Projection	Control Strategy
Interstate/ Freeway/ Expressway	3.25	1.16	1.16	3.97	2.74	2.74
Major Arterial	3.85	1.55	1.55	3.68	2.40	2.40
Minor Arterial	4.82	2.06	2.00	3.35	2.21	2.24
Collector	4.82	2.12	2.12	3.35	2.18	2.18
Local	5.04	2.24	2.24	3.19	2.12	2.12

*Adjusted for typical summer conditions.

Figure 4.2 Emission reductions for highway sources

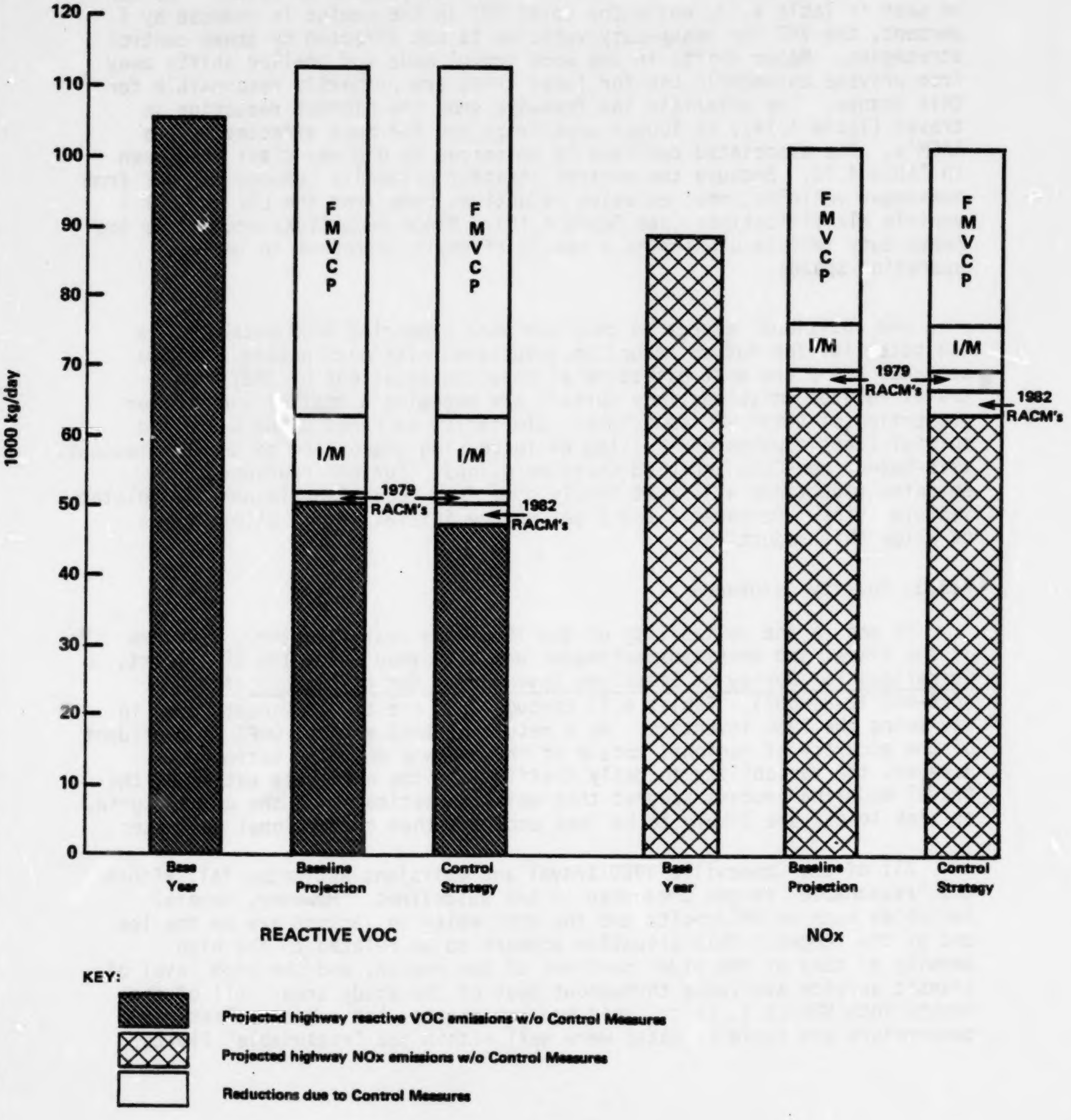

Table 4.12 presents the emission reductions attributable to each of the four packages of RACM's in the 1982 SIP. Approximately 40 percent of the total VOC emission reduction from the control strategy RACM's is from package A while 75 percent comes from packages A and B combined. Similarly, 74% of the NOx emission reduction comes from the same packages.

The control strategy packages are primarily effective in reducing the number of passenger vehicle trips and their associated emissions. As can be seen in Table 4.13, while the total VMT in the region is reduced by 5 percent, the VMT for heavy-duty vehicles is not effected by these control strategies. Major shifts in the work travel mode and smaller shifts away from private automobile use for local trips are primarily responsible for this change. The arterials and freeways show the highest reduction in travel (Table 4.14), as longer work trips are the most effected by the RACM's. The associated declines in emissions by highway class are shown in Table 4.15. Because the control strategy primarily reduces the VMT from passenger vehicles, most emission reductions come from the LDV and LDT 1 vehicle classifications (see Table 4.16). Minor reductions occur from the heavy duty vehicle classes as a result of small increases in vehicle operating speeds.

One additional aspect to consider when comparing RACM packages, is the potential for future reduction associated with each package. While packages A & B are most effective at reducing emissions by 1987, the travel related emissions they curtail are becoming a smaller and smaller proportion of total VOC emissions. Similarly, packages C and D are the initial steps towards controlling an increasing proportion of total emissions, trip-based, non-CBD, and cold start emissions. Further transportation emission reductions will most likely come from reductions in non-CBD related vehicle trips. Packages C and D set up the initial set of alternatives to allow this reduction.

4.3.3 Quality Assurance

To ensure the reliability of the 1980 base year inventory, a review of the travel and emissions estimates was performed using the EPA report, Guidelines For Review of Emissions Inventories For Highway Emissions. (EPA-440/12-80-002). Tables 4.17 through 4.22 are the worksheets used in reviewing the 1980 inventory. As a result of this review, ORPA is confident of the accuracy of regional totals of the highway emission estimates. However, the variability in daily traffic, and the aggregate nature of the travel modeling process suggest that emission estimates at the county, grid, or link levels are likely to be less accurate than the regional estimates.

All of the Ozoneville 1980 travel and emissions estimates fall within the "reasonable" ranges presented in the Guidelines. However, several variables such as VMT/capita and the NMHC emission factors are on the low end of the ranges. This situation appears to be related to the high density of many of the older portions of the region, and the high level of transit service available throughout most of the study area. All of the inputs into MOBILE 1, (e.g., cold and hot starts, the vehicle fleet mix, temperature and humidity data) were well within the "reasonable" limits.

Both on-network and off-network travel are included in the VMT estimates. The model assignments have been validated recently (1977), and the models used are consistent with the state of the art in travel forecasting. The Base Year, Baseline Projection, and Control Strategy inventories were all subject to extensive in-house and public review before being approved for use in the emission inventory.

Although no specific review methodology was applied for the 1987 travel and emissions estimates, both the Baseline Projection and Control Strategy inventories have been checked for reasonableness relative to 1980 conditions. The 14% increase in VMT between 1980 and 1987 (see Table 4.10) is considered reasonable in light of the continued growth of the suburban communities. The increase in the average vehicle operating speed is primarily due to the growth of travel on uncrowded suburban arterials rather than on already congested or nearly congested radial routes and CBD arterials. Also contributing to improved speed are the expected increase in peak hour transit ridership, and the improvement of traffic flow conditions through new construction and signalization.

TABLE 4.12 EMISSION REDUCTIONS FROM RACM PACKAGES IN THE CONTROL STRATEGY

	VOC (kg/day)			
County	Package A	Package B	Package C	Package D
A	400	250	75	75
B	75	150	75	130
C	600	500	100	100
D	125	120	70	122
Total	1,200	1,020	320	427

	NOx (kg/day)			
County	Package A	Package B	Package C	Package D
A	460	300	125	125
B	78	150	75	130
C	780	650	140	150
D	126	120	70	122
Total	1,444	1,220	410	527

TABLE 4.13 AVERAGE DAILY VMT BY VEHICLE CLASSIFICATION*

Classification	Base Year	Baseline Projection	Control Strategy
LDV	20,813,210	23,846,292	22,625,937
LDT 1	1,246,300	1,427,922	1,210,776
LDT 2	747,780	856,752	711,184
HDG	747,780	856,752	856,752
HDD	1,246,300	1,427,922	1,427,922
MC	124,630	142,792	142,792
Total	24,926,000	28,558,432	26,975,363

* Using MOBILE I Vehicle Classifications

TABLE 4.14 AVERAGE DAILY VMT BY HIGHWAY CLASSIFICATION

Highway Classification	Base Year	Baseline Projection	Control Strategy
Interstate/Freeway/ Expressway	3,489,640	3,998,181	3,797,323
Major Arterial	9,970,400	11,423,373	10,471,102
Minor Arterial	5,234,460	5,997,271	5,779,662
Collector	2,492,599	2,855,844	2,750,609
Local	3,738,901	4,283,763	4,176,667
Total	24,926,000	28,558,432	26,975,363

TABLE 4.15 EMISSIONS BY HIGHWAY CLASSIFICATION

	Reactive VOC (kg/day)		
Classification	Base Year	Baseline Projection	Control Strategy
Interstate/Freeway/ Expressway	11,341	4,638	4,405
Major Arterial	38,386	17,706	16,230
Minor Arterial	25,230	12,354	11,559
Collector	12,014	6,054	5,831
Local	18,844	9,596	9,356
Total	105,815	50,348	47,381

	NOx (kg/day)		
Classification	Base Year	Baseline Projection	Control Strategy
Interstate/Freeway/ Expressway	13,854	10,955	10,404
Major Arterial	36,691	27,416	25,130
Minor Arterial	17,535	13,254	12,947
Collector	8,350	6,226	5,996
Local	11,927	9,082	8,855
Total	88,357	66,933	63,332

TABLE 4.16 HIGHWAY SOURCE EMISSIONS BY VEHICLE CLASSIFICATION

	Reactive VOC (kg/day)			NO_x (kg/day)		
Classification	Base Year	Baseline Projection	Control Strategy	Base Year	Baseline Projection	Control Strategy
LDV	79,990	38,063	36,062	51,866	39,290	36,701
LDT 1	5,820	2,769	2,349	3,181	2,410	2,046
LDT 2	5,720	2,719	2,254	3,358	2,543	2,112
HDG	9,312	4,431	4,380	7,422	5,622	5,534
HDD	4,338	2,064	2,042	22,549	17,048	16,920
MC	635	302	294	26	20	20

TABLE 4.17

Reviewer - John Doe

Date - April 2, 1981

METHODOLOGY REVIEW SHEET

1. **Urban Area** - Ozoneville

2. **What agency developed the base year HC and NOx emissions inventories for highway sources? (List agency name, address and telephone number.)**

Ozoneville Regional Planning AuThoriTy
1000 MAIN ST.
Ozoneville, USA (312) - 312 - 3122

3. **a) For what base year have the emissions inventories been established?** 1980

b) If 1980 is not the base year for the emission inventories, indicate why another year was used.

4. **What type of procedure was used to estimate highway emissions? (Check one)**

- ☒ - **Link-based procedure** *
- ☐ - **Trip-based procedure** *
- ☐ - **Hybrid procedure** *
- ☐ - **Other (Please explain below)**

* **Section II of this manual describes each of these procedures in more detail.**

TABLE 4.17 (cont.)

5. a) **How were VMT and vehicle operating speeds estimated for use in developing the emissions inventories? (e.g. Are the estimates based on traffic counts and travel time surveys or are they based on estimates from the travel forecasting procedures used for urban transportation planning?)**

UTPS, four step planning models were used to estimate speed and VMT.

b) **Are there any elements of the travel estimation procedures that are questionable?**

No

c) **What year's data was used to calibrate the travel estimation procedures cited in Question 5a?**

1960

d) **When were the procedures cited in question 5a last validated (i.e., checked to determine if they can reproduce observed traffic flows)?**

1977

6. **Are estimates of "off-network" VMT (e.g., VMT on links normally not included in a computerized highway network) accounted for in the highway emissions inventories? If yes, briefly describe how the VMT and corresponding operating speeds estimates for each travel were determined.**

Yes. VMT is computed as the number of intra-zonal trips for each zone times one-half the over-the-road radius for that zone. Speeds are assumed.

TABLE 4.17 (cont.)

7. a) What procedure was used to estimate mobile source emission factors? (Check one)

☒ MOBILE 1
☐ MOBILE 2
☐ Other procedure (Enter name of procedure) ________________

b) If "Other" was checked in question 7a, describe and assess the adequacy of the procedure.

8. Based on the above, summarize and briefly discuss any major deficiencies in the travel and emissions estimation procedures used by this urban area.

There are no apparent deficiencies

TABLE 4.18

WORKSHEET 1

TRAVEL DATA FOR REASONABLENESS ASSESSMENT

NAME OF URBAN AREA Ozoneville

REGION OF COUNTY (SEE FIGURE 2) NE

VARIABLE	ESTIMATE FOR BASE YEAR		SOURCE
	VALUE	UNITS	
1. Population	2,060	1,000's	ORPA STaTisTics
2. Average Daily VMT by Functional Class *		1,000's of vehicle miles	ORPA Travel Modeling Process
a) Interstate	3,490	(000)	
b) Principal Arterial	9,970	(000)	
c) Minor Arterial	5,234	(000)	
d) Collector	2,493	(000)	
e) Local	3,734	(000)	
f) Total	24,926	(000)	
3. Average Daily VMT by Vehicle Class **		1,000's of vehicle miles	ORPA Travel Modeling Process
a) LDV	20,813	(000)	
b) LDT 1 (< 6000 lbs.)	1,246	(000)	
c) LDT 2 (> 6000 lbs.)	747	(000)	
d) HDG	747	(000)	
e) HDD	1,246	(000)	
f) MC	125	(000)	
g) Total	24,926	(000)	
OR			
h) Auto		(000)	
i) Truck		(000)	
j) Total		(000)	
4. Average Daily Operating Speeds (24 hrs.) by Functional Class *		in miles per hour	ORPA Travel Modeling Process
a) Interstate	45	mph	
b) Principal Arterial	32	mph	
c) Minor Arterial	22	mph	
d) Collector	22	mph	
e) Local	20		
OR			
f) Average Daily Speed for the System (where a-e aren't available.)	28.9	mph	
5. Average Daily Trip Length	———	minutes	
6. Average Daily Vehicle Trips		in 1,000's	ORPA Travel Modeling Process
a) Passenger Vehicles	3,912	(000)	
b) Trucks	440	(000)	
7. Seasonal Adjustment Factor	1.10		

* Functional classifications, see Appendix C.

** MOBILE 1 vehicle classifications, see Appendix C.

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TABLE 4.19

WORKSHEET 2a

EMISSION FACTOR INPUTS AND EMISSION INVENTORY OUTPUTS, REASONABLENESS ASSESSMENT

NAME OF CITY Ozoneville

VARIABLE	ESTIMATE FOR BASE YEAR VALUE	UNITS	CRITERIA	FINDINGS
8. Average Daily Cold Start/ Hot Start Fractions		Percent	See TABLE 2	
a) Cold Start Catalyst	29	%	17-30	OK
b) Hot Start Catalyst	21	%	18-27	
c) Cold Start Non-catalyst	19	%	17-30	
9. Meteorological Data			See Table 9	The variation of Temperature by Time of day is acceptable
a) Summertime Temperature	Varies between 72-85	°F	85	
b) Summertime Humidity	103	Grains/lb.	Indicate Source National Weather Service	
10. Total Annual Highway Emissions				
a) HC	38,411	Tons	None	
b) NOx	32,074	Tons	None	

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TABLE 4.20

WORKSHEET 2b

VARIABLE 11: FRACTION OF VMT PER VEHICLE CLASSIFICATION BY MODEL YEAR

AGE	LDV		LDT 1		LDT 2		HDG		HDD		MC	
	B.Y.E.*	N.A.V.**	B.Y.E.	N.A.V.	B.Y.E.	N.A.V.	B.Y.E.	N.A.V.	B.Y.E.	N.A.V.	B.Y.E.	N.A.V.
1	N.A.V.	.106	N.A.V.	.093	N.A.V.	.061	N.A.V.	.061	N.A.V.	.102	N.A.V.	.107
2		.142		.136		.116		.116		.178		.286
3		.133		.126		.116		.122		.168		.216
4		.123		.129		.115		.124		.149		.140
5		.108		.097		.090		.098		.101		.085
6		.092		.082		.081		.088		.081		.051
7		.077		.075		.075		.079		.067		.036
8		.064		.057		.062		.063		.046		.025
9		.050		.044		.050		.049		.031		.021
10		.035		.031		.042		.040		.021		.016
11		.023		.023		.033		.030		.016		.005
12		.016		.015		.022		.020		.009		.003
13		.010		.018		.025		.021		.008		.008
14		.007		.016		.023		.019		.006		.000
15		.004		.014		.020		.016		.006		.000
16		.003		.012		.018		.014		.004		.000
17		.002		.011		.016		.012		.003		.000
18		.002		.009		.014		.011		.002		.000
19		.002		.008		.012		.010		.002		.000
20		.002		.007		.010		.009		.001		.000

Findings: OK

* B.Y.E. = Base Year Estimates

** N.A.V. = National Averages Used as Default Values in Mobile 1.

TABLE 4.21

WORKSHEET 2c

VARIABLE 12: VEHICLE EMISSION RATES BY FUNCTIONAL CLASS (GM/VMT)

	COMPOSITE EMISSIONS		TOTAL AUTO EMISSIONS		TOTAL TRUCK EMISSIONS	
	ESTIMATE	CRITERIA	ESTIMATE	CRITERIA	ESTIMATE	CRITERIA
HIGHWAY CLASSIFICATION		See Fig. 3 or 9 for HC See Fig. 4 or 10 for NOx		See Fig. 5 or 11 for HC See Fig. 6 or 12 for NOx		See Fig. 7 or 13 for H See Fig. 8 or 14 for N
Speed 45 (MPH) INTERSTATE						
Non-Methane HC	3.25	3.25 - 4.10				
NOx	3.97	3.90 - 5.70				
Speed 32 (MPH) PRINCIPAL ARTERIAL						
Non-Methane HC	3.55	3.51 - 4.50				
NOx	3.68	3.64 - 5.10				
Speed 22 (MPH) MINOR ARTERIAL						
Non-Methane HC	4.82	4.78 — 6.33				
NOx	3.35	3.31 - 4.70				
Speed 22 (MPH) COLLECTOR						
Non-Methane HC	4.82	4.78 - 6.33				
NOx	3.35	3.31 - 4 70				
Speed 20 (MPH) LOCAL						
Non-Methane HC	5.04	5.02 - 6.62				
NOx	3.19	3.15 - 4.60				
Speed 25.9 (MPH) TOTAL						
Non-Methane HC						
NOx						

Findings: Emission factors are low, but within the "reasonable" range.

Directions: Enter the average daily operating speeds from rows 4a through 4e (in Worksheet 1) in the first column. If MOBILE 1 was used to compute emissions factors, use figures 3 through 8 in Appendix A to select appropriate reasonableness criteria. If MOBILE 2 was used, see Fig.'s 9 through 14 in Appendix A. Draw a vertical line, on the appropriate figures for HC and NOx at the average vehicle operating speed for each VMT stratification. The intersection of the vertical line with the two solid curves in each figure determines the reasonableness range for that VMT stratification. That range should then be placed in the appropriate column and row in the Table. For VMT stratification by other functional classes, use this Table and method, but note the new column headings in the space marked "Findings". For an example of this procedure see Appendix D and Figures 3 and 4.

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TABLE 4.22

WORKSHEET 3

REASONABLENESS ASSESSMENT FOR TRAVEL DATA

VARIABLE	BASE YEAR REASONABLENESS MEASURES		CRITERIA	FINDINGS
	MEASURE	COMPUTATION		
13. Daily VMT/Capita	12.1 mi/per.	(2f÷1a)	See TABLE 3 12 - 15 mi/person	OK
14. Percent VMT by Functional Class			See TABLE 4 (Percent)	
a) Interstate	14 %	(2a÷2f)	13 - 21 %	OK
b) Principal Arterial	40 %	(2b÷2f)	38 - 62 %	OK Generally
c) Minor Arterial	21 %	(2c÷2f)	12 - 21 %	OK OK
d) Collector	10 %	(2d÷2f)	6 - 18 %	OK
e) Local	15 %	(2e÷2f)	7 - 9 %	High
15. Percent VMT By Vehicle Class			(Percent)	
a) LDV	83.5 %	(3a÷3g)	78-88 %	OK
b) LDT (< 6000 lbs.)	5.0 %	(3b÷3g)	5-12 %	OK
c) LDT (> 6000 lbs.)	3.0 %	(3c÷3g)	2.5-6 %	OK
d) HDG	3.0 %	(3d÷3g)	1.5-4.5 %	OK
e) HDD	5.0 %	(3e÷3g)	2.5-7.5 %	OK
f) MC	0.5 %	(3f÷3g)	0-1 %	OK
OR				
g) Auto	%	(3h÷3j)	78-90 %	
h) Truck	%	(3i÷3j)	10-22 %	
16. Total VMT	1,000 mi/day 24,926	(2g or i)	See 2f, worksheet 1 1,000 mi/day 24,926	OK
17. Vehicle Operating Speed by Functional Class			See TABLE 5 (miles/hour)	
a) Interstate	45	(4a)	45 - 50 mph	OK
b) Principal Arterial	32	(4b)	25 - 30 mph	- High Generally
c) Minor Arterial	22	(4c)	20 - 25 mph	OK
d) Collector	22	(4d)	20 - 25 mph	OK OK
e) Local	20	(4e)	15 - 20 mph	OK
OR				
f) Average Vehicle System Speed	---	(4f)	See TABLE 6 mph	
18. Average Daily Trip Length	——— min.	(5a)	See TABLE 7 (minutes)	
19. Vehicle Trips/Capita				
a) Passenger Vehicles	1.90 Trips/per.	(6a÷1a)	1.3-2.4 Trips/per.	OK Generally
b) Trucks	.21 Trips/per.	(6b÷1a)	.27-.48 Trips/per.	slightly low OK
20. Seasonal Adjustment Factor	1.10 ———	(7a)	See TABLE 8 1.09 - 1.15	OK

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5.0 QUALITY ASSURANCE

The Ozoneville Regional Planning Authority (ORPA), as lead agency for compiling the emissions inventory for the 1982 ozone SIP, has also assumed the lead role in setting up a quality assurance program. As such, ORPA has engaged in a number of activities at all stages of the inventory process to help assure that inventory errors are minimized. These activities are briefly itemized below.

POINT SOURCES

- ORPA compared the major VOC sources listed in the Department of Environmental Regulation (DER) point source data file with independent listings in order to identify missing facilities. Primary emphasis was on major VOC sources covered by RACT which were identified in Directory of Volatile Organic Compound (VOC) Sources Covered by Reasonably Available Control Technology (RACT) Requirements, Volumes I, II, and III, EPA-450/4-81-007 a,b,c. Any missing sources were identified to DER for inclusion in the point source mailing list.

- Where possible, employment data from DER's individual point source listings were summed (by source category) and compared with totals published (by SIC) in County Business Patterns. If serious discrepancies were found, additional effort was expended by DER in locating the missing sources and adding them to the data base. In cases where a significant portion of the employment in particular categories was associated with small facilities emitting much less than the point source cutoff level (250 kg/day), emission-per-employee factors were applied to handle the small facilities, in aggregate, in the area source inventory.

- A review was conducted by ORPA's engineering department of the source and emissions data coded in DER's point source files. Data items checked for reasonableness were: classification codes, activity levels, control measures and efficiencies, and emission factors. ORPA also checked whether all operations were included that would normally be associated with each type of facility, whether the appropriate nonreactive solvents were excluded from consideration in the inventory, and whether correct procedures were used for estimating summer weekday emissions from annual data.

- In a limited number of cases, followup plant visits were made to verify the data reported in the mail survey. During these visits, all processes were reviewed, the quantity and types of solvents used were verified, and growth and control device data were obtained for use in making projections. Selected stack tests were conducted.

AREA SOURCES

- A general review was conducted by senior level ORPA staff (not originally involved in the area source effort) of all activity levels and emission factors used in the emission calculations.

- A check was made to make sure all significant area sources of VOC and NO_x were included, the appropriate nonreactive solvents were excluded from the emission totals, and that appropriate control reductions were projected in 1987.

HIGHWAY VEHICLES

- ORPA's four-step transportation planning process includes a validation step wherein simulated traffic volumes projected by the models are compared with actual ground counts. In addition, an iterative, capacity-restrained technique is used to estimate travel occuring on each link in the highway network. The latter process is repeated until a reasonable traffic assignment is completed.

- ORPA reviewed its base year travel and emissions estimates using the EPA report, Guidelines for Review of Emissions Inventories for Highway Emissions. Ozoneville's data were checked to see if they fell within "reasonable" ranges presented in the Guidelines.

(Note: More detail on the highway vehicle quality assurance program is given in Section 4.)